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On the Improvement of the Ohio River. By ELLWOOD MORRIS, Civ. Eng.

The rapid settlement of the country west of the Alleghenies, and especially of the North Western United States, the vast increase of commercial wealth in the States bordering the Ohio River, the dependence of that commerce upon the waters which originated it, the working operations of the Pennsylvania Central, and Baltimore and Ohio Railroads, (whose receipts are seriously diminished by low water,) and the progress westward of the Virginia Central Railroad, all unite with other obvious considerations, to give more than usual weight at the present time, to a proposition for permanently improving the navigation of the Ohio River, and making it available at all seasons for the transit of the largest steamboats.

All these great railroads have their western termini upon the banks of the Ohio, and notwithstanding their prolongation westward by other railways, the *two* now in operation, are found to be very much dependent upon the navigation of its waters for the magnitude of their business.

These *three* great trunk lines of railroad, *two* of them now in successful operation, having ultimately, *four* terminal stations in communication with the Ohio River, and being capable of furnishing prompt and powerful means of steam transportation over the mountain ranges to the Atlantic seaboard, add greatly to the present importance of a perennial Ohio

River navigation, as through these railroads the products of the West, water-borne to their termini, may reach those points of transhipment more economically, than in any other possible way ; and having reached them by means of steam power upon the water, will be drawn across the Alleghenies by steam on land, over great iron roads, on which all the resources of modern art have been lavished.

Prior to the construction of these railroads, this question had less importance, for the canals and turnpikes could never have borne away the products of the West as rapidly as they could have been brought forward to the transhipping points, by the Ohio River steamers, if moving upon an adequate depth of water. But these new and modern means of transportation—these great iron roads—will enable us to take away from the banks of the Ohio, and promptly lead across the mountains to the sea-side, whatever the steamboats may be able to bring to their termini—and this assimilation of the capacity of carriage by land and water now or recently developed for the first time—obviously and favorably changes the whole aspect of this question, and offers the strongest inducement for the immediate improvement of a navigation from which such great results may confidently be anticipated.

These and other facts of recent origin have rendered a permanent navigation of the Ohio River, of more consequence perhaps to the central United States, than any other scheme of internal improvement, which has lately been agitated, or is likely soon to invite the attention of the public mind.

To replace the uncertain and fitful navigation of the Ohio River, by a certain and permanent one, ready for use at all times and seasons, and adequate to bear upon its bosom steamboats of the first class, would doubtless prove the highest benefit that could now be conferred upon the commerce of the bordering states.

The states of Pennsylvania, Ohio, Virginia, Kentucky, Indiana, Illinois, and Missouri, with the leading cities which concentrate their commerce, are more than ever interested in an adequate improvement of this great river, since the developement of the power of steam transportation upon the iron roads, across the mountain ranges, gives certain assurance of the existence of an ability to promptly lead the bulky products of the Ohio valley, directly to the sea. The inducements however to the improvement of the Ohio River, and the material benefits that cannot fail to flow from it, are so great, so numerous, and so obvious, that it is out of the power of the writer to notice them adequately in the prefatory portion of a technical communication: nor is it indeed necessary to do so, for the reflections of the intelligent reader, will not fail to supply any deficiency in this branch of the subject.

Of the Plans for Improvement.—Lieut. Maury, in his Physical Geography of the Sea, has well said, that: "The atmosphere pumps up our rivers from the sea, and transports them through the clouds, to their sources amongst the hills." And one of our most eminent meteorologists, many years ago, proposed to the Congress of the United States, to arrest the water in these vapory conveyances *by means of fire*, and to maintain the navigation of the Ohio River *by producing rains at will, upon its sources.*

Whatever may be thought of the practicability, or of the efficacy, of the means proposed by this eminent meteorologist for the attainment of a practical end, of such magnitude—it is evident that the great idea was fully grasped by him, *of maintaining the navigation by equalizing the flow, or supplying by his intended rains, as though from reservoirs, the deficiencies of that flow, during the dry season.*

This great idea—*that the failure of the navigation of the Ohio River, is due to the failure of the supply of water alone, and that a restoration of the deficiency at will, solves at once the important problem of forming a perennial navigation*—has been more recently taken hold of by one of our ablest Civil Engineers, and elaborated into a beautiful practical system, which insures the control and supply of the requisite quantity of deficient water, by arresting it amongst the hills soon after its deposit from the clouds, and regulating its passage from artificial receptacles, so as to insure, and to maintain, a uniform navigable flow of adequate depth in the channel of the Ohio River, throughout the entire year.

As the idea of improving the navigation by supplying the deficient water, leaves the channel of the Ohio precisely as it now is—*free from obstructions of every kind*, and accessible at all times, by every town and village on both its shores—it has in this, as will be seen hereafter, a vast advantage over every other plan, all of which propose to place obstructions of some sort in the navigable channel, and then to overcome those self-created obstructions by artificial means.

The Government of the United States, with the view of improving the navigation, have already placed obstructions in the channels, which are real nuisances at several points—and they have expended large sums upon the *wing dams*, forming the attempted improvement.

The system of *wing dams* proceeds upon the simple idea *of concentrating the low water flow of the river, by contracting its channel at occasional points.*

This has been pretty fully carried out upon the Upper Ohio, and though in use for years, it is to this day a debatable question amongst the Ohio River men, whether or not, any good at all has resulted from these operations of the Government; and while it may be admitted that in some cases the wing dams have been slightly useful, it is quite clear that in others they have been absolutely injurious—whilst as a whole, the wing dam improvement must be regarded *as a most decided failure;* which fully confirms the experience of European engineers, on the utter inadequacy of this method to form a permanent improvement of a river navigation.

Of late years *three* plans (and only three), which seem at all practicable, or in any degree adequate to the object, have been proposed for the improvement of the Ohio River navigation.

1. *The Plan of Reservoirs or Artificial Lakes.*
2. *The Plan of Dams and Locks, or Slack-water Navigation.*
3. *The Plan of Low Dams and Chutes, or Pool and Current Navigation.*

Of these *three* plans, the first alone is complete within itself—as both the second and third require the aid of reservoirs to insure their successful operation in practice, and thus admit them as *auxiliaries.*

The writer proposes to consider these plans in succession, but will notice the two latter only briefly, as *the Reservoir Plan* is, beyond all comparison, the first in importance—the most certain of success—and the most likely to be satisfactory to the people of the West—since it proposes no obstructions in the river, *which both the others do.*

I. *The Reservoir Plan.*

This plan originated in the genius of Charles Ellet, Jr., Esq., an able civil engineer, whilst engaged in the construction of the celebrated suspension bridge over the Ohio River, at Wheeling, Virginia, and was very fully developed by him in a paper laid before the Smithsonian Institution, September 17th, 1849, and published by authority of that body.

Some additions have since been made by the same author (while subsequently employed by the War Department, upon the Mississippi overflows), and the whole has been embodied and re-published in a handsome octavo volume, by Lippincott, Grambo & Co., of Philadelphia, 1853.

From these papers much of what follows is derived, and the acknowledgment is now made for the materials used, but the treatment of the subject is the writer's own, and for which he alone is responsible.

This explanation is made because the writer, in support of the reservoir plan, proposes to subject it to the most unfavorable test, in order to remove all possible objections, a test which the author of the plan would hardly sanction, but one that demonstrates its entire practicability, and its adequacy to the object *at a moderate cost*, though much greater in point of expense, than the author of the plan has proposed.

Mr. Ellet availed himself of the means at his command at Wheeling, to make such measurements of the Ohio River in that vicinity as enabled him to deduce a formula, from which the flow of the River could be correctly calculated when the depth of water upon the Wheeling Bar was known, and of this data fortunately a regular diurnal record has been preserved and reported from 1838 to 1848—*eleven years.*

Six of these years—1843 to 1848 inclusive, have been mainly employed in the illustration of this subject; the daily depths of water upon Wheeling Bar during these *six years*, have been profiled by the writer from the tables given, and will be found at Plate I., which exhibits to the eye at one view, the great variations of the daily surface of the Ohio River as marked on Wheeling Bar, the shaded portions showing the daily deficiencies, *under the line of six feet deep*, which it is proposed to make good by means of reservoirs.

The first great question that arises is:—*whether the ordinary annual flow of the Ohio River at the City of Wheeling, is adequate to the maintenance of a permanent steamboat navigation six feet deep, if this flow could by any means be equalized throughout each and every year?*

This is decisively answered by Mr. Ellet, in the following statement of the aggregate flow for six years, in which the discharge of the River is computed day by day from the empirical formula based upon adequate measurements.

"The total discharge of the Ohio (at Wheeling) was in

1843 =	961,382	*millions of cubic feet.*
1844 =	650,982	"
1845 =	555,482	"
1846 =	879,119	"
1847 =	1,142,258	"
1848 =	822,719	"
Total for six years, =	5,011,942	"
Annual average, =	835,323	"
Daily average, =	2,287	"

or by the formula, adequate to have maintained throughout this term of six years, *an uniform depth of nearly nine feet!*

From this statement it appears, that *double* the quantity of water descended the river in the maximum year 1847, when compared with the flow of the minimum year 1845, and it also appears that *the average* daily flow supplies nearly *twice* the quantity of water, which is necessary to maintain a constant depth of *six feet* water in the steamboat channel.

The surface drained above Wheeling is estimated "at 24,337 square miles, or 678,476 *millions* of square feet," and in each of the above years the drainage (or available downfall water) was computed to be as follows:

Inches vertical.	Inches vertical.
1843 = 17	1846 = $15\frac{55}{100}$
1844 = $11\frac{52}{100}$	1847 = $20\frac{20}{100}$
1845 = $9\frac{83}{100}$	1848 = $14\frac{57}{100}$
Total drainage for six years, =	$88\frac{67}{100}$
Annual average, =	$14\frac{778}{1000}$

Assuming "the average annual fall of rain at the head of the Ohio," to be about 36 inches, this available downfall is equivalent to about 40 per cent. of the usual rainfall of an average year; which is somewhat less than the results obtained by other engineers in this country, who have been called upon to plan or build reservoirs for canals or water-works, and to compute the vertical drainage of their basins, which can be concentrated in them annually, from an area of country carefully surveyed.

To illustrate this subject further, we avail ourselves of data furnished from the personal experience of William J. McAlpine, Esq., Civ. Eng., in his able Report upon the Brooklyn Water-works.

Year experimented on.	Name of stream gauged.	Elevation above tidewater in feet.	Character of the water shed.	Whole rainfall in ins. per annum.	Vertical downfall drained away by the streams.	Ratio of available drainage to the whole rainfall, per cent.	Locality.
1835 and 1836	Eaton Brook,	1350	Steep and impervious.	34	23	66	Madison Co. NY
	Madison Brook,	1200	Less steep and more pervious	35	17½	50	the same.
1850 and 1851	Patroons Creek, near R.R junct'n	300?	Flat country.	46	25	55	near Albany NY
	Patroons Creek, near Tivoli Falls	300?	Flat country.	42	17½	42	the same.
	Totals,	3450	Mixed.	157	83	213	State of
	Averages,	862	Mixed.	39	21	56	New York.

English experiments quoted by Mr. McAlpine, give generally much higher ratios of drainage to rainfall, (though with some exceptional cases;) thus, in ten localities in England, the ratios were 43, 49, 53, 54, 60, 61, 66, 67, 82, and 83 per cent., *averaging about sixty-two per cent.;* the results of this humid climate, however, are not considered as entirely applicable here.

"Some experiments made by order of the Water Commissioners of the City of Boston, in 1837 and 1838, show that in the drainage of Long Pond, about 11,000 acres, *forty-four per cent.* of the falling water, passed off through the streams."

The Silver Creek Reservoir of the Schuylkill Navigation, near the summit of the Broad Mountain, in Schuylkill County, Pennsylvania, at an elevation of 1512 feet above tide-water, and 115 miles distant therefrom, was located by the writer in 1847, and calculated to use the entire drainage upon an assumed available downfall of 13⅕th inches, or about 37 per cent. of the average rain-fall of three feet.

The construction of this reservoir (of which the whole surface drained had been accurately surveyed), proved conclusively to the mind of the writer, after observing its working for several years as Superintendent of the navigation—that the ratio of drainage assumed in its location *was too low;* and that *fifty per cent.* at least of the rain-fall could have been utilized on *that* reservoir site. The drainage of the basin of Anthony's Creek, a tributary of the Great Kanawha, has been shown by the measurements of E. Lorraine, Esq., C. E., to have been 65½ per cent. of the rain-fall, on an average of five years; that average rain-fall having been 36½ inches per annum.

The writer, therefore, thinks it safe to assume, that in the construction of reservoirs near or upon elevated grounds, with moderately steep watersheds of ordinarily impervious material, *fifty per cent. of the rain-fall, or eighteen inches vertical, may be utilized in reservoirs.*

The question being settled beyond any doubt that the ordinary flow

of the Ohio River, if uniformed throughout the year, is more than adequate for the object, the second great question is,—*can this flow be equalized wholly or partially, and in what manner?*

Before entering upon the solution of this question, it is proper to state that the largest steamers in use upon the Upper Ohio, require but *six feet* plumb depth of navigable water for their floatation *loaded;* and that with *six feet* depth of water in the channel, the river is known to have been closed *by ice* but very rarely in its history, and with that depth flowing uniformly away, before and during cold weather, *a closure by ice would probably never occur.*

If, then, we can partially equalize the flow, so as to maintain regularly a navigable depth *of at least six feet water* in the Ohio River, we shall overcome at once, both the great obstacles which now so seriously impair the usefulness of that noble river, as to have partly justified the celebrated sneer, that "it was *dry* half the year, and *frozen* the other half!"

Can we partially equalize the flow so as to insure and to maintain six feet plumb depth of navigable water, and by what means?

The answer is, *by Reservoirs.* The same means which have been successfully used for two centuries, upon canals *when short of water.*

For the Ohio River technically considered, is merely a grand canal, 1000 miles long, and 1000 feet wide, with an average descent of half a foot to the mile, and it admits of being supplied with water by the same means as other canals, only proportioning those means properly to the magnitude of the case.

So long as a navigable depth of *six feet water* is produced by the natural flow, the navigation of the Ohio is all that can be desired, *but when the water fails, of course the navigation fails.*

Keep up the supply of water then, and the navigation becomes *perennial.*

The parts of canals which have hitherto been supplied with water from reservoirs in this country and elsewhere, are usually either summits, or the higher levels where the ordinary flow of the country is inadequate, and, hence, these reservoirs required to be located in an elevated country, and were, consequently of comparatively small dimensions, though at the same time they probably availed of a deeper rain-fall than has been realized on lower ground.

Upon various canals in this country, over *twenty* of these reservoirs are now in successful use.

Now, the Ohio River forms the lowest line in its valley, and lays so far below the level of the upper waters of its leading tributaries, as to render it easy to find sites for reservoirs of vast magnitude—*not mere ponds, but artificial lakes in fact*—and nothing less will answer, in the view the writer proposes to take of this question.

Mr. Ellet, contemplating the establishment of comparatively small *receiving reservoirs*, to be filled and emptied frequently during each year, and controlled in their discharge by *regulating reservoirs* upon the larger affluents, has declared that, "It is not his intention to recommend the construction of dams upon the great navigable tributaries of the Ohio, until the appropriate sites upon the smaller affluents have been first exhausted."

And he has most ably argued his case, *upon the hypothesis of small*

receiving reservoirs frequently filled and emptied every year, and controlled in their discharge by regulating reservoirs.

This view necessarily results in a very moderate outlay for *reservoirs*—a cost so small indeed, as stated by the author of the plan, as to have raised the strongest doubts in the minds of many; and though in this form, the case has been stated with rare ability, and proved by the author of the plan, to the very verge of demonstration, nevertheless this reasoning does not appear to have carried to all minds the conviction due to the merits of the argument, and it cannot be denied that many have doubted its adequacy, while some have even gone so far as to consider it chimerical.

Whilst, therefore, Mr. Ellet has taken, probably, the most favorable view of the results to be expected from the admirable plan devised by him—it may be well to examine it *in its most unfavorable aspect*, for the satisfaction of those who receive these new ideas with difficulty.

It is this task which the writer proposes to himself,—to examine the feasibility, and the probable results of the Reservoir Plan, *upon the ordinary hypothesis applied by Engineers to the construction of reservoirs to feed canals*, where the whole deficency of water is first ascertained, and then the reservoir capacity is calculated, to collect and control that deficiency, *upon the supposition of the reservoirs being filled and emptied but once a year.*

This will be judging the Reservoir Plan by a much more severe test, than its able author has thought proper to subject it to—by one indeed harder than may be necessary, but which must be considered as the most unfavorable view that can be taken of this great question, and as a test adequate to settle all doubts upon the subject.

We will therefore assume, *that the reservoirs are filled and emptied but once a year*, and will take for our guide the year 1845 (see Plate I.) as being the most difficult to manage of all those which Mr. Ellet has tabulated; a year in which for 218 days, the waters of the Ohio River were less than six feet deep on Wheeling Bar, and of which the entire flow, if fully equalized, would only have furnished an uniform depth of *seven feet* throughout the year.

Using Mr. Ellet's methods of computation we find approximately that the deficiencies of that year (1845), below our proposed navigable gauge of 6 feet deep on Wheeling Bar, were as follows—disregarding those days when the water was 6 feet deep or more.

Deficiencies of 1845, *under 6 feet deep, on Wheeling Bar.*

			Cubic Feet.
January	= 2	days of deficiency under 6 feet deep =	450 Millions.
February	= 8	" " " =	1,725 "
March	= 0	" " " =	0 "
April	= 21	" " " =	9,705 "
May	= 20	" " " =	11,930 "
June	= 25	" " " =	17,452 "
July	= 24	" " " =	14,746 "
August	= 31	" " " =	24,744 "
September	= 30	" " " =	20,388 "
October	= 15	" " " =	6,341 "
November	= 17	" " " =	6,714 "
December	= 25	" " " =	12,015 "
Totals	**218**		**126,210 Millions.**

In this year then, disregarding the times when the water was *over six feet deep*, we have more or less deficiency, occurring on 218 days (some in every month but one), and amounting in the aggregate to a deficient flow, *requiring a supply of the very large quantity of* 126,210,000,000 *cubic feet of water per annum.*

With this striking example before us, we will now assume in round numbers that the deficiency necessary to be supplied to make good *six feet* plumb depth of navigable water the year round, may in some unfavorable years, amount to the very large quantity *of* 150,000 *millions of cubic feet of water per annum;* and that this quantity will have to be annually accumulated and held in reservoirs, if, as we are now supposing, *these reservoirs can be filled and emptied only once a year.*

This will be admitted to be a most severe hypothesis by which to test the Reservoir Plan, but it will appear plainly too, we hope, before the close of this discussion, that the plan is adequate even to such a test.

Proposing to go back upon the great tributaries of the Ohio, the Allegheny, and the Monongahela, we should seek our reservoir sites in or near the elevated country, where we should find an available rainfall *deeper* than the average drainage from the whole valley taken together, *and where eighteen inches deep over the whole surface drained may safely be assumed as the proportion of downfall water which may, one year with another, be utilized in reservoirs.*

We have then $\frac{150,000,000,000}{1{\cdot}5} = 100,000$ millions of square feet of surface drainage required to fill our reservoirs *once a year.*

And $\frac{100,000,000,000}{27,878,400} = 3587$ square miles of drainage needed, or in round numbers, *say* 3600 *square miles.* This is equal to a square area of 60 miles on a side, or to *six* oblong areas of 40 miles long by 15 miles wide.

Can we find six reservoir sites upon as many creeks, each draining a basin equivalent to 40 miles long by 15 miles wide?

Can proper locations be found at the lower ends of these basins for the *six* dams necessary to form *six* lakes, commanding each a drainage of 600 square miles? Or for a greater number of lakes of equal aggregate capacity?

These questions the writer believes, can be answered in the *affirmative*, by a well conducted survey, and they form the only questions of importance, which remain unsettled in the discussion of this great subject.

For the present we will assume, (what we do not doubt,) that *six* suitable sites can be found, and that six dams can be erected on them, *each* ponding back, or giving an annual available capacity of 25,000 millions of cubic feet of water, or 150,000 millions per annum in all. And now let us see what sort of dams these lakes would require? what the proximate extent of the pool? and what the nature of the feeding apparatus?

We will here observe, that the reasoning which leads the writer to conclude that suitable reservoir sites can be found, is based upon a knowledge of these facts.

1. That the channels of the leading tributaries of the Allegheny and

Monongahela, or certain portions of them, descend at the rate of about four feet to the mile.

2. That reservoir dams are always located in the contractions of valleys. Consequently, locations would be sought, (and doubtless found,) upon streams descending about four feet per mile; while the dams would be placed in gorges where such streams break through ranges of hills.

Established at proper points upon such streams, dams of 100 feet *water raise*, would swell back about 25 miles upon the main streams, and swell out above the gorges to a width of a mile or more, and up all the small affluents, to an extent that will give us probably an average breadth of surface of near $\frac{3}{4}$ths of a mile, with an available depth of 50 feet; these dimensions would give us 25,000 millions of cubic feet of water, the quantity required for our purpose in each of *six* reservoirs, and such sites in the opinion of the writer, may be readily found by suitable surveys.

The writer is the more confident in the expression of this opinion in consequence of having been called on in the course of his professional experience, to locate *eight* reservoirs, and to construct *two*. Those who have had occasion practically to locate the dams, and to see the water lines of reservoirs patiently traced out upon the ground, with the spirit level, will not hesitate (we believe) to admit the strong probability of adequate sites being found of the dimensions stated, ***but this question can be determined absolutely only by survey.***

Admitting that sites can be found, whereon with proper works, we might store up for use *in each of six reservoirs*, the large quantity of 25,000 millions of cubic feet of water, the next question is, *are such works practicable?*

The answer to this by every civil engineer must be in the affirmative, for reservoirs form some of the oldest constructions, known to the profession as well as some of the most recent.

From the Saint Ferrèol Reservoir, constructed in 1667, on the Languedoc Canal, in the heart of France, (and still in successful use,) down to the *twenty* reservoirs constructed of late years by the civil engineers of this country to feed various canals, the formation of such works has been well understood, and they have invariably been successful.

To show the method usually adopted in this country, for the construction of such works; the writer refers to the transverse sections of three reservoir dams (see Plate II., Figs. 1, 2, 3,) of which a brief description only, will be necessary.

They are formed by a heavy mound of water-tight earth thrown across a valley at a suitable point; this bank of earth is connected with solid and impervious bottom, by a deep longitudinal excavation called the puddle-ditch, subsequently filled with the best material attainable, and wetted if practicable. At the ends, this puddle-ditch filling is connected with, and stepped up upon impervious ground, cut into deep benches. The mound is always protected and weighted upon the exterior or land-side by means of a mass of stone called the riprap, and is often secured on the water-side with a slope wall of stone.

In all cases, these mounds of earth require to be combined with a

wide waste wier excavated into the hill, on one or both sides, and fully adequate *to waste the entire stream in flood when the reservoir is full.*

Referring now to Plate II.

Fig 1. Is a transverse section of the Reservoir Dam, constructed by the Schuylkill Navigation Company, in 1848 (under the direction of the writer), on the head of Silver Creek, in Schuylkill County, Pennsylvania.

Fig. 2. Is a cross section of the Reservoir Dam (called the Berger Reservoir,) constructed by the Union Canal Company, in 1849, on a branch of the Swatara, near Pinegrove, Schuylkill County, Pennsylvania, under the direction of Wm. Lehman, and B. B. Lehman, Esqs., Resident Engineers, (who have kindly furnished the Section).

Fig. 3. Is a transverse section of a Reservoir Dam, now, 1856, in the course of construction (under the direction of the writer), by the Pottsville Water Company, at Pottsville, Penna.

DETAILS.

a. Valve house containing the stop-cocks. (Double.)
b. Riprap formed of coarse stone.
c. Puddle-ditch, sunk to impervious material.
d. Head of pipe wall, of cement masonry.
e. Feed pipes (12 inches), laid on cemented masonry.
f. Water of the Pool formed by Dam.
g. Embankment of earth, carted in thin layers.

The chief novelty in these reservoirs, is the mode of feeding *from the lower ends of the pipes*, first adopted by the writer at Silver Creek, in 1847, and since successfully applied to two other reservoirs. At the lower end of *each* pipe are two stop-cocks, both so arranged as to be accessible at all times for repairs and supervision, and one of which acts as a guard for the other.

These transverse sections, with the references above, fully explain themselves, and are introduced here to show *that these constructions are common and well understood works of engineering.*

In 1837 or '38, *two reservoirs* were constructed for the State of New York (by John B. Jervis, Esq., Chief Eng., and William J. McAlpine, Esq., Assistant Eng.), for the purpose of feeding the Chenango Canal; one of these had *a water raise* of 45 feet, and the other of 50 feet, and both had similar sections to those marked upon Plate II.

In 1839 and subsequent years, the State of Pennsylvania, to supply her mainline of canal, constructed two reservoirs at the foot of the Allegheny Mountains, one on either side—the Eastern Reservoir has *a water raise* of 28 feet—the Western Reservoir of 62 feet; they both have transverse sections generally, similar to those of Plate II, having slopes *inside* of 2 to 1, and *outside* of $1\frac{1}{2}$ to 1, with heavy ripraps externally. These were planned and chiefly constructed by William E. Morris, Esq., Civil Engineer.

It seems unnecessary to multiply examples where the constructions are all so similar; *over twenty reservoirs* are now in successful use upon the canals in this country, performing towards them in dry seasons, precisely the same offices as the reservoirs proposed by Mr. Ellet will perform, towards the Ohio River.

The Saint Ferrèol Reservoir, built in 1667, the oldest large reservoir in existence, has the following leading dimensions: (Andreossi's Histoire du Canal du Midi.)

Water Raise	=	103. feet.
Height of Dam	=	107. "
Length "	=	2558. "
Thickness at base	=	394. "

This Reservoir Dam was constructed of earth, with a walled breast of stone-work, curiously arranged. (See De Lalande's Canaux de Navigation-Canal de Languedoc.)

It is this great structure, the durability of which has been so amply tested by the hand of time, that will be taken by the writer, as the prototype of those suggested in this paper.

Our proposed Reservoir Dams, therefore, will have the general dimensions, and the same water raise as that of Saint Ferrèol, built in 1667, *in successful use for nearly two centuries, and the practicability of imitating which cannot be doubted.*

We come now to consider the feeding works necessary to stop and to let loose, *at will*, the vast body of water, which we propose to pen up in these *six* artificial lakes and see what difficulties they may involve.

The Ohio River flow in the driest season is never less than *one foot deep* upon the Wheeling Bar, but the navigable depth we need is *six feet;* the maximum quantity of water, therefore, that can ever be required in any 24 hours is the difference of the river flow at these depths for that time, or the quantity required daily, to produce and to maintain, a raise of 5 feet upon the lowest water depth of one foot—now by Mr. Ellet's tables:

	Cubic feet per day of 24 hours.
6 feet deep on Wheeling Bar, flows, .	= 1,164,000,000.
1 do. do. .	= 102,000,000.
Difference or maximum daily quantity required from reservoirs in dry weather,	= 1,062,000,000.

Divided by *six*, therefore, the feeding apparatus of each reservoir must have a maximum power under all circumstances, of expending 177,000,000 of cubic feet of water in 24 hours, *or of* 2049 *cubic feet per second.*

To expend this quantity per second would require

Under	100	feet	head =	7	pipes of 3 feet diameter each.
"	16	"	=24	"	"
"	4	"	=36	"	"

Now, inasmuch as all the reservoirs would rarely retain at any moment of their working operation precisely the same depth of water, it seems evident that 24 *cast iron* feeding pipes, of 3 feet diameter each, would form an ample feeding apparatus, even for these artificial lakes.

Three feet in diameter is not an uncommon size for water pipes—it is the same employed in the mains of the City of New York—and of that diameter, stop-cocks are made working with a screw, which, under 100 ft. head, could be readily operated by *two men* with suitable wrenches, or even by *one man* if necessary.

We will now refer to Plate II., fig. 4, which shows a transverse section

of a dam suitable for the formation of our proposed artificial lakes. The mound is proposed to be founded upon rock, and sustained and protected in front by a great mass of cemented masonry, by means of notches, in which, of the proper length, and twelve feet deep, adequate waste wiers will be formed on both sides, one on each.

That a structure of this kind is entirely practicable, and that it would make a substantial and durable work, will, we think, be admitted by every professional reader; and it now only remains to indicate roughly the probable cost.

The Estimated Cost of One Dam.

Cemented Masonry (Rubble Work), 203,000 Pers. at $4,	=	$812,000
Embankment, 1,150,000 cubic yards at 30c.,	=	345,000
24 Feeding Pipes (36 inch), 7200 ft. lineal at $15,	=	108,000
48 (36 inch.) Stop-cocks at $350 each,	=	16,800
Preparing Foundation, Puddling, &c.,	=	100,000
Clearing site, forming roads, &c.,	=	150,000
Valve house, and houses for attendants,	=	50,000
For eventually riprapping the interior slope,	=	100,000
12,000 acres of land at $10,	=	120,000
Engineering and contingencies,	=	198,000
Total for each Lake, say,		$ 2,000,000

Or, for the whole six artificial lakes, say twelve millions of dollars.

We come now to speak of the probable cost of maintaining and operating reservoirs.

It is the uniform experience of all Engineers who have had the charge of properly constructed works of this nature, *that they cost little or nothing for repairs.*

The reason is obvious; these works properly constructed consist of nothing but earth, stone, and iron, in masses suitably protected, and hence have not within them or about them, any elements of decay.

Within the first few years, settlements of the bank have to be made good, and the interior slope eventually, when well settled, should be protected with a riprap or slope wall of stone, for all which, the estimate we have offered makes due provision; once come to stability or the construction ended, there is nothing remaining to be done while earth, stone, and iron endure, and this is the actual experience with existing reservoirs.

With regard to the attendance in operation, it may be observed, that works of this value and magnitude, require to be carefully watched and warded day and night to prevent depredations and interference; these watchmen, when directed, will open and close the valves; and for these purposes a force of *four men* at each reservoir would be ample; less force indeed might do, as canal reservoirs have only the attendance of a single man each; but we will assume that *four* are necessary; the *six* dams will therefore require, say 24 men, and including materials, tools, oil, paint, &c., the cost of actual maintenance at all these reservoirs cannot exceed a total of $15,000 per annum.

As collateral to this subject, we will now add a few words upon the probable effect of such large reservoirs upon the Ohio River floods.

Although it is an incident (and a very important one,) that the Reservoir Plan must necessarily act to a considerable extent to moderate the

floods of the Ohio River, it does not come within the scope of the present paper to discuss that question.

It is proposed herein to form lakes of great capacity for the continued support and maintenance of six feet navigation alone; nevertheless, as those lakes are calculated to cover and to cut off the drainage of 3587 square miles out of 24,337 square miles, or over one-seventh of the whole drainage above Wheeling, and as their capacity, too, is computed to intercept the high ratio of 18 inches vertical of the whole annual rain-fall, there cannot be a doubt that they will operate materially for the reduction of floods.

For every year of which we have any history, shows some deficiency, and usually a very large one, under the line of six feet water, which is well illustrated by the shaded portions of Plate I, and as these shaded portions are to be filled by reservoirs intercepting the flood waters, they must cut off an equal quantity from those high peaks of the profiles which represent the floods.

We think it certain, then, that by a method of management which experience would soon indicate, reservoirs of the magnitude contemplated here, cannot fail to effect a great amelioration of the freshets of the Ohio River.

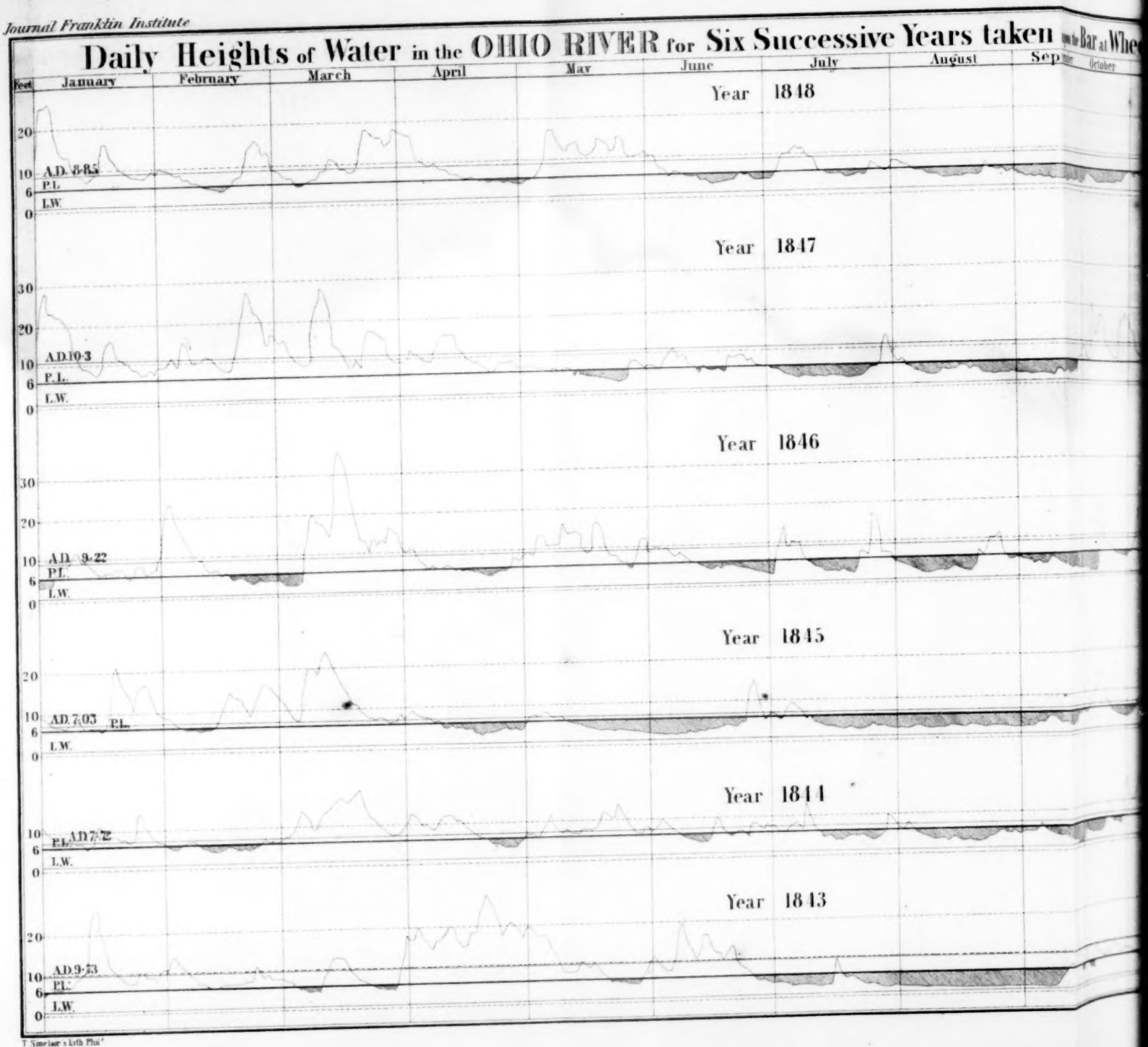
We will now present a brief summary of the results arrived at in the discussion of *the Reservoir Plan.*

DEMONSTRATED CHIEFLY BY THE AUTHOR OF THE PLAN.

1. That the average rain-fall in the basin of the Upper Ohio if intercepted by reservoirs in wet seasons for use in dry ones, is more than sufficient for the maintenance of six feet depth of navigable water throughout every year.
2. That the water draining away by the channel of the Ohio River as measured day by day at Wheeling, Virginia, if regulated by reservoirs, is more than adequate to the maintenance of a navigable depth of six feet throughout each year.
3. That by means of reservoirs, the equalization and regulation of the flow of the Ohio River, to the extent necessary to maintain a permanent steamboat navigation six feet deep, can be certainly and economically effected.
4. That reservoirs are common and well understood works of engineering, which when judiciously located and constructed, never fail in their object, and that over twenty of them are now in successful use upon various canals in this country alone.
5. That six feet depth of navigable water is ample to maintain a permanent steamboat navigation, and also to keep the river clear of stoppage by ice.
6. That by employing receiving and regulating reservoirs of small size, frequently filled and emptied annually, a navigable depth of five feet* could be maintained, by means of an outlay in reservoirs of only one million of dollars.
7. That by using six large artificial lakes, to be filled and emptied but once a year, a navigable depth of six feet can be permanently maintained by an outlay in reservoirs of twelve millions of dollars.
8. That the reservoirs constructed of imperishable materials will require no repairs, when once properly finished.
9. That the expense of operating the reservoirs in the maintenance of six vertical feet of water, by means of six artificial lakes, will not exceed $15,000 dollars per annum.
10. That six artificial lakes of the size herein contemplated, could not fail to exert a material influence in moderating the Ohio River floods.

We will conclude this branch of our subject by observing; it appears evident, that taking the most *favorable view* of the Reservoir Plan, an outlay of only one million of dollars in reservoirs may maintain a *five feet*

* Mr. Ellet has framed the reservoir plan, and argues it at present, with a view to *five feet* depth of water only, and by the use of reservoirs often filled and emptied every year, proposes to effect this, for the astonishingly small outlay named.


Daily Heights of Water in the OHIO RIVER for Six Successive Years taken
Bar at Whee
Feet
January
February
March
April
May
June
July
August
September
October
Year 1848
A.D. 8·85
P.L.
L.W.
Year 1847
A.D. 10·3
P.L.
L.W.
Year 1846
A.D. 9·22
P.L.
L.W.
Year 1845
A.D. 7·03
P.L.
L.W.
Year 1844
P.L. A.D. 7·72
L.W.
Year 1843
A.D. 9·53
P.L.
L.W.
T. Sinclair's Lith. Phil.

RIVER for Six Successive Years taken upon the

May | June | July | August | September

Year 1848

Year 1847

Year 1846

Year 1845

Year 1844

Year 1843

upon the **Bar** at **Wheeling Virginia.**

tember | October | November | December

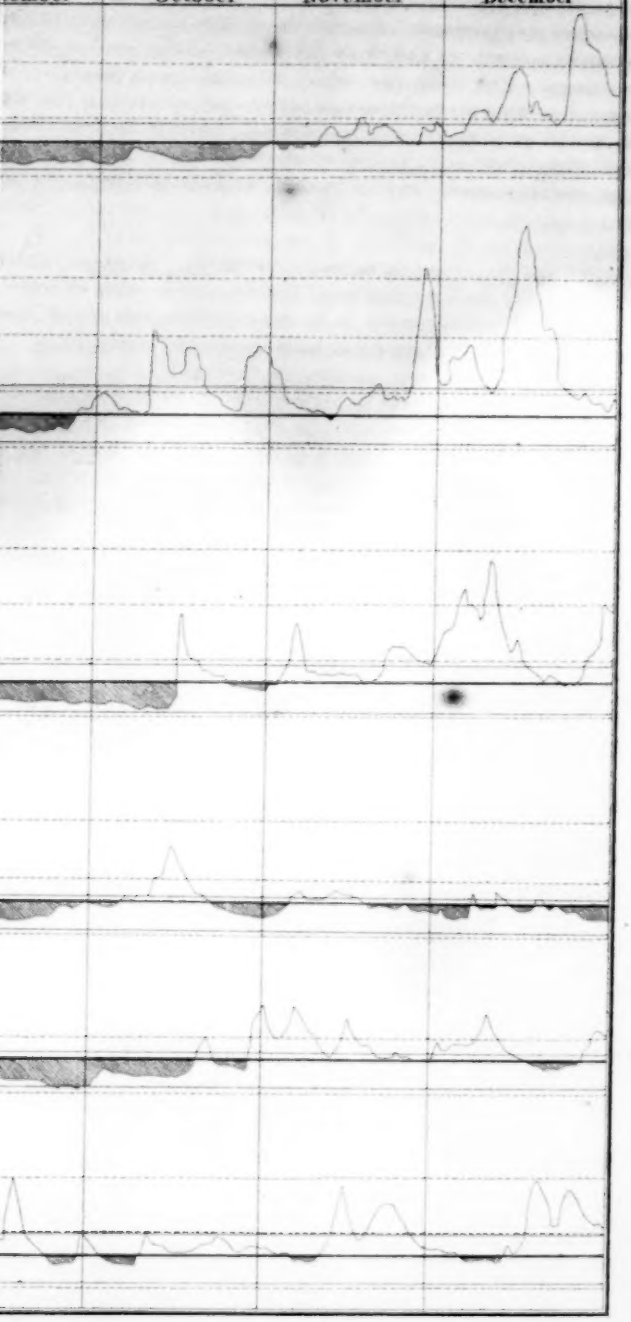


Fig. 1.

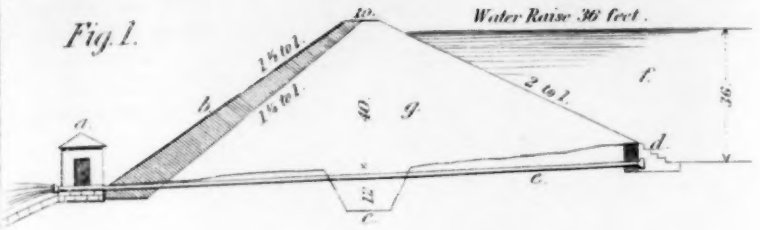


Fig. 2.

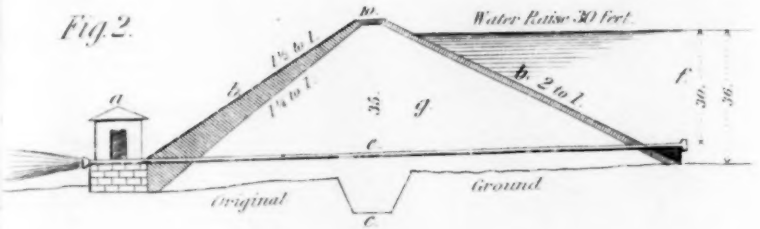
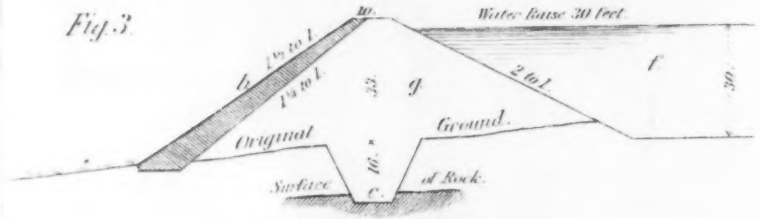
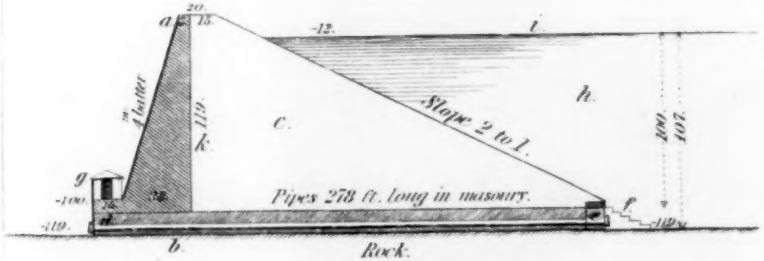


Fig. 3.



Scale 50 ft. to the inch.

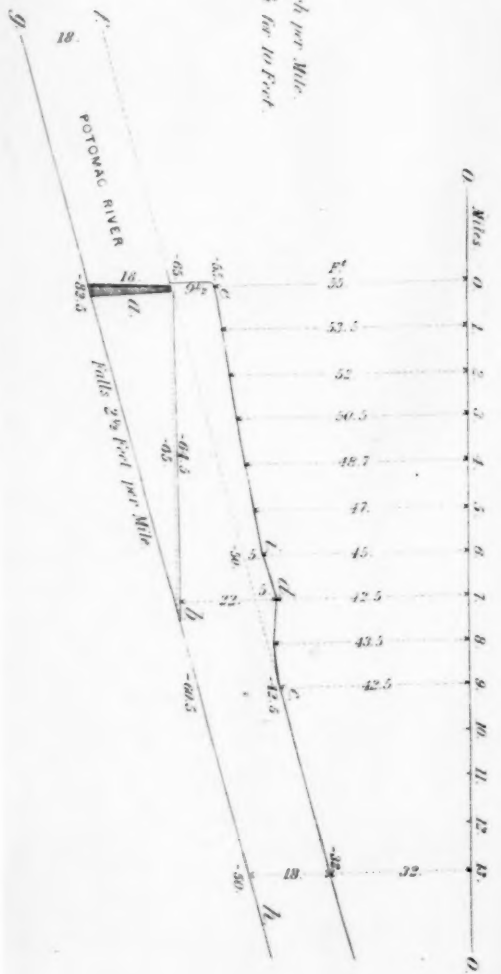
Fig. 4.



Scale 100 ft. to the inch.

Fig. 5.

Horizontal Scale 1 inch per Mile.
Vertical Scale ½ inch for 10 Feet.



navigation, while by taking the most *unfavorable view*, a permanent navigation *six feet deep* in the Ohio River can be certainly established by an outlay of twelve million of dollars.

We will now proceed to discuss the other plans proposed for the improvement of the Ohio River navigation.

REFERENCES TO PLATES.

PLATE I. Daily heights of water in the Ohio River, for six successive years, taken upon the Bar at Wheeling, Virginia, and Profiled from the Tables of Charles Ellet, Jr., Civ. Eng.

The shaded parts show the deficiencies required to be supplied in each year *from reservoirs* to make good a navigable depth of six feet throughout each year.

O. Level of top of Bar at Wheeling, or zero of the Wheeling water gauge.
LW. Lowest water at Wheeling, or one foot deep upon the Bar.
PL. Proposed level to be maintained by Reservoirs, equal to an uniform navigable depth of six feet.
AD. Average depth of each year, supposing the flow to be equalized throughout.

PLATE II. *Fig.* 4.—Proposed section of Dam for artificial lake.

a. Rubble wall laid in cement.
b. Foundation of wall and bank on rock.
c. Bank of earth, carted in thin layers.
d. Outlet of the three feet feeding pipes.
e. Inlet of the three feet feeding pipes.
f. Head-wall of feed pipes, laid in cement.
g. Valve-house, for the feeding arrangement.
h. Water ponded back, or body of the lake.
i. Water surface of the lake.
k. Rear of wall, to be plumb, and plastered with cement.

PLATE II. *Fig.* 5.—Freshet Profile of Dam, No. 5, of the Chesapeake and Ohio Canal, on June 1st, 1836.

a. The Dam, a wooden crib-work, the comb, = 17½ feet above common low water.
b. Surface of Pool at common low water, about 6 inches above the comb.
c. d. e. " " the highest of the Freshet, by levels taken on the spot.
f. c. Top level of the Freshet, beyond the influence of the Dam, showing also top water, supposing Dam removed.
g. h. Surface of ordinary low water in the Potomac River, ascertained by accurate levels.
o. o. Reference level, or Datum line.
b. Point where level of comb strikes the level of common low water. Dotted line is level of comb of Dam. At points *d. e.* rise of Freshet over the line *f. c.* = 5 feet.

(To be Continued.)

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*Description of the Drainage of the Haarlem Mere.**

(Continued from Vol. XXXII—page 370.)

The principal condition of the contract with the district was, that in summer the level of the *boezem* should not be raised more than 17 centim. (6·¾in.) above M. L., while in the winter 15 centim. more, or 32 centim. (12½ in.), were allowed. These conditions have, to a great extent, increased the duration of the work, and accordingly the expense of the drainage, while they necessitated the constant stopping of the engines, when the prescribed level was attained. In the meanwhile, the enclosure

* From the Lond. Artizan, August, 1856.

of the lake was finished, and two other engines were constructed of the same power and arrangement as the *Leeghwater*, with some few modifications, which have been indicated above. One of the two is placed on the spot where the river *Spaarne* unites with the intercepting canal, the greatest quantity of water raised by it being conducted to *Spaarndam*, where it is discharged into the Y. It is called the *Cruquius*, after the name of a man who, in the year 1742, made a skilful plan for draining the mere, while the other is placed on the north side, in the vicinity of the sluices at *Halfweg*. It is called the *Lynden*, in honor of Van Lynden van Hemmen, Bart., who in 1822 published an excellent treatise on the drainage of the mere, but did not live to see the realization of his cherished idea. Both these engines are indicated on the map by their respective names. The building of the *Cruquius* was contracted for, for a sum of 220,665 fl., but to this sum are to be added 10,000 fl. for the unusual difficulties encountered in laying the foundations, which were of such a nature that the contractor had nearly given up the work, so that the total cost has been 230,665 fl. (£19,222). The soil, at the depth required for the foundation, was of such a nature that the utmost energy and nicety of skill were required to overcome the almost insurmountable difficulties. It consisted of a layer of shale, through which water and sand percolated with such force that a portable steam engine of 10 H. P., and three other machines for raising water, moved by sixty horses,* were not capable to discharge the water and sand at the same rate as it entered at the bottom. At the same time, the sides of the pit were forced out by the superincumbent weight, so that another mode of working had to be adopted, or the work given up. Therefore, to prevent the sides of the pit from slipping, heavy deals were driven in the bottom, close against them, one near the other, forming, as it were, an immense tub, so that the water could not enter then through the bottom, whence it was duly discharged by the addition of a fourth machine, so that a power of no less than eighty-four horses, besides the steam engine, were night and day at work to raise the water, which entered continuously with great force. During this time, no less than 1700 piles had to be driven in the bottom of the pit, and a woodon platform laid on their tops; this work had to be carried on with the greatest possible dispatch, no less than 450 men being at work in the pit at the same time. In this manner art has triumphed over the obstacles, so that the building has been elevated on a firm and secure foundation. The other building presented no difficulties whatever, and was erected for a sum of 218,528 fl. (£18 210).

The two engines, with the levers and boilers, were contracted for by the same firms which had constructed the *Lerghwater*, for a price of 639,423 fl. (£53,285). They were to be finished in August, 1848, but

* The machines generally made use of in Holland for draining deep foundations are a sort of noria, consisting of a square wooden trunk lying at an angle, it being open at both ends; the bottom end enters the water and the top is laid at the level to which the water has to be raised. An endless chain, passing over rollers, at the top and bottom of the trunk, passes through it, being provided at short distances with square boards, fitting nearly in the trunk. The upper roller being moved by horse-gear, the water contained between each pair of boards is conveyed to the required height and discharged at the top.

from various circumstances it was not before the beginning of 1849 that they could be set at work.

In the meanwhile the drainage of the mere was commenced by the *Leeghwater* alone, which had been set in action, discharging the water from the lake, on the 7th of June of the preceding year, the level of the mere being at that time 0·13 met. (5 ins.) below M. L. The *Cruquius* commenced pumping on the 1st of April, 1849, the *Lynden* eighteen days afterwards. The first engine had lowered the level of the mere during the time of its working 0·14 met. (5½ ins.) At this time the drainage may be reckoned to have commenced, it being finished in July, 1852, occupying thirty-nine months, a greater time than was calculated, but which is explained by the following statement:—

The three engines made, during this space of time, together, 14,004,032 strokes,* discharging (deducting $\frac{1}{10}$th for leakage), 831,839,501 cubic met. (817,712,236 tons) of water. At the commencement of the drainage the depth of water in the lake was 3·21 met. (10 ft. 5 ins.), which, with an area of 18,100 hectares, gives a cubical content of 581,010,000 cubic met. The rain which fell during this period has, according to very careful observations, been in excess of the evaporation by the trifling quantity of 0·0202 met. (0·7753 ins.), giving for the surface of the lake 3,656,200 cubic met., so that the total quantity of water in the mere, added to the falling rain water, amounted to 584,666,200 cubic met., falling short by 247,173,301 cubic met. (244,253,745 tons) of the calculated quantity pumped out. This difference may be partly ascribed to leakage, which undoubtedly on many occasions has been greater than $\frac{1}{10}$th of the quantity raised, and partly to the strokes not always being full; but these causes cannot answer for the great difference which must for the most part be ascribed to filtration through the bottom and sides. This filtration, which is met with in all similar drainage works, but in this instance in a rather greater proportion than usual, goes on decreasing afterwards, when the newly-laid embankments are thoroughly dried and settled, but never disappears totally. It depends on the greater or less porosity of the soil, which, especially on the north-west side in the vicinity of the river *Spaarne*, is of a very light and porous nature. Heavy repairs were required, which, on an average, caused a delay for each engine of three months, the inadvertency of an engine driver causing the breaking down three of the heavy levers at the *Leeghwater*, while, by some unknown cause at the *Cruquius*, the ears of the great cap for the guide-rods were broken off. The buckets and foot-valves required many repairs, caused principally by the great quantity of mud collecting on the platform on which they stand, so that it had to be cleared many times, for which purpose the building had to be isolated from the mere by dams. But the greatest delay was caused by the regulations of *Rhynland* requiring the engines to stop, when the level of the *boezem* was raised to a certain height.

By these combined causes, the engines were in full work but half of the time during the drainage—viz: nineteen months and a half. The water pumped out exceeded the quantity expected (which was, as before stated, 766,000,000 of cubic met.), by nearly 66,000,000 cubic met.,

* This number of strokes is reduced to the total number of pumps.

requiring one month and a half to be pumped out, increasing the calculated time to fifteen months and a half, leaving out a difference of four months, which is to be ascribed to the speed at which the engines were worked being less than was calculated, this being considered necessary for safety. Even assuming the very improbable circumstance, that the filtration will not decrease, the calculations show that under the most unfavorable circumstances, the engines are capable of removing the greatest possible quantity of water that may collect in a month, which has been proved by the experience acquired during the three years the lake has been dry.

In the preliminary plan it had been fixed that a fourth sluice-gate should be added, to the three existing at *Halfweg*, for giving the water a better discharge at that point. The Commissioners, however, had delayed the execution of this work, so as to watch and be able to judge correctly of the action of the steam engine at *Spaarndam* on the *boezem*, as also the influence of the enclosure of the mere, on the affluence of the water to these sluices, the water being now conducted only from the two sides of the canal. This experience showed that the existing sluices were more than sufficient to discharge the water in the direction indicated, but they saw the desirableness of erecting another steam engine. Accordingly the placing of a steam engine, after the manner of that at *Spaarndam*, was resolved upon, but pecuniary difficulties delayed the execution of this plan until the year 1850. For this engine one of the existing sluice gates has been utilized in such a manner, that when natural discharge takes place this sluice works as before, while, when needed, the water is discharged through it by the steam engine. This engine has a nominal power of 100 horses, being condensing and expansive, the steam pressure being three atmospheres. The cylinder is horizontal, diameter, 1016 met. (40 ins.); stroke, 2·44 met. (8 ft.) On each side of the engine are three flash-wheels, having a diameter of 6·60 (21 ft. 8 ins.), and a breadth of 2 met. (6 ft. 6¾ ins.), lying at such a height, that they can even work at spring tides. Their axles are not, as at *Spaarndam*, in a line with the crank axle of the engine, but are moved by spur wheels and pinions in such a proportion that as the engine makes 13½ revolutions per minute (its normal speed) the wheels make 6 revolutions. The axles of the wheels are furnished with coupling-boxes, so that according to a greater or less difference of level, one or more of the wheels may be coupled. To supply steam to this engine there are three cylindrical boilers with internal flues. Diameter of boilers, 1·68 met. (5 ft. 6 ins.); diameter of flues, 1·02 met. (3 ft. 4 ins.); length, 8·53 met. (28 ft.) Above and across these boilers is placed a steam chest, having a length of 6·40 met. (21 ft.), and a diameter of 1·22 met. (4 ft.)

The engine should have been finished in June, 1852, but was not ready until 1853, so that it was not worked until after the drainage of the mere was finished. It has, however, since done good service in discharging the water from the *boezem* of Rhynland. Had it been erected in 1848, it would have contributed much to shorten the time of the drainage. It was constructed by Messrs. Paul van Vlissingen and Dudok van Heel at Amsterdam, for a sum of 79,924 fl. (£6660), while the building was erected for the sum of 94,762 fl. (£7897).

During the drainage of the mere, no unusual wet years occurred; for had such been the case, the engines must have been stopped for a much longer time, in order not to raise the level of the *boezem* of Rhynland too much, which during this time discharged its superfluous water on the points before named. But now, after the drainage, the same necessity for a good discharge exists, and much more than before, for while formerly the superfluous water of 70,000 hectares (173,000 acres) was received on a *boezem*, having an area of 22,700 hectares (54,538 acres), the superfluous water of 88,000 hectares (217,460 acres), has to be received on a *boezem* of which the area is but 5000 hectares (12,356 acres), so that its level is raised in a much shorter time. Therefore, the existing means were considered insufficient to meet unfavorable circumstances, and a sum of 200,800 fl. (£16,600), was allowed for the erection of a third steam engine, equal to that at *Halfweg*, for the discharge of the *boezem*. This engine, which at this very moment is in course of construction, is intended to be placed at *Gouda*, to bring the water on the river *Yssel*. With the aid of these powerful means, there is not the least danger of the district of *Rhynland* being overflowed, for except by the three steam engines, the water is discharged at Katwyk, on the North Sea. The great value of the engines for discharging the *bozeem* may be shown by the statement that during the year 1854, and the first four months of the following year, the engine at *Spaarndam* has raised about 184,000,000 cubic met.; and that at *Halfweg*, in the same time, about 107,000,000, making together a volume of 291,000,000 cubic met. (304,000,000 of tons.) Three great pumping engines have drawn from the mere, which after the drainage is called *polder*, since the 1st July, 1852, unto the 1st May, 1855, 398,000,000 cubic met., being at the rate of 140,000,000 yearly, or 7700 cubic met. per hectare, corresponding with 3067 tons per acre. This gives a height of 0·77 met., rather more than 30 inches for rain and filtration water, which is considerably more than that found by Mr. Glynn, viz.—24 ins. giving 7260 cubic feet per acre and per month, while this height gives 9166 cubic feet. It must, however, not be overlooked, that this quantity will decrease after some years, but the nature of the soil is such that a considerable quantity of water will always percolate through it.

The mere being dry, it remained to be divided, and suitable drains, roads, and bridges had to be constructed. It was a point of consideration to fix the area of each piece enclosed by drains, so that it should not be too small, whereby too much valuable ground was occupied by the drains, and, at the same time, not too great, whereby the drainage might be imperfect. In the earlier drainages by wind-mills, the collective area of the catch-water drains occupied an area of $\frac{1}{10}$—$\frac{1}{12}$th of the whole surface; but in the case of land drained by steam power so great an area is not required, while the drains have not to retain the water until the blowing of a favorable wind, but can be discharged at the rate of their being filled. It was accordingly resolved to divide the land in pieces, surrounded by drains of an area of 20 hectores (49·4 acres), having a length of 1000 met. (1060 yards), and a breadth of 200 met. (212 yards), and lying in the direction from north-west to south-east. By this division but $\frac{1}{3}\frac{1}{2}$ of the whole area is occupied by the drains, the principal

canal or drain having a width of 25 met. (82 ft.) runs in nearly a straight line from the *Leeghwater* to the *Lynden* engine, having a length of about 20½ kilomet. (12¾ miles), while another drain of the same dimensions, perpendicular on it, conveys the water to the *Cruquius*. Three drains of smaller dimensions—their width being but 8 met. (26¼ ft.)—run parallel to, and on each side of, this main drain, being crossed by six similar drains, whereby the land is divided into squares, which again being divided longitudinally by roads in two parts, form areas of 300 hectares (741 acres), which by the minor drains are again subdivided in fifteen pieces of 20 hectares, as indicated above. The drains are indicated on the map by straight, thicker or thinner lines—the roads by two parallel lines (=). Except the small drains, dividing the squares formed by the main drains, about 180 kilomet. (112 miles) of drains, nearly 200 kil. of road and about sixty-five bridges have been constructed, of which twelve are over the principal main drain. These works have been executed for a sum of 1,261,199 fl. (£105,099). After this was accomplished, the ground had to be sold, which was done in the three consecutive years, 1853, 1854, and 1855. These sales have produced much more than was expected, 16,822 hectares having been sold for 7,972,400fl. or on an average at the price of 473 fl. per hectare (£16 2*s.* 8*d.* per acre). An area of 32 hectares (79 acres) has been reserved for the building of villages, after a fixed plan, this area being valued at a sum of 7000 fl. (£583.) The quality of the land is not the same in all places, some tracts being of the first, and others of an average quality; but on an average it is good. For the most part rape seed is cultivated, it being the best crop for newly drained grounds. The crops of 1855 have been excellent, as well as regards quality as quantity.

To complete this description, it only remains to give a review of the total expense. For the drainage was borrowed, a capital of 9,916,344 fl. (£826,362) nominally, but which amounted to no more than 8,429,344 fl. effective, to which were added afterwards, at different periods 552,000 fl. so that the total allowed sums amounted to 8,981,344 fl. (£748,445).

The following table gives the amount of the expenses from 1839 until the end of 1855:—

	Florins.	£.
1. Works for improving the discharge of the *boezem* of Rynland, viz: the widening of the canal and sluice-gate of *Katwyk*, the improvement of the *Spaarne*, the erecting of the steam-engines at *Spaarndam* and at *Halfweg*, with that in course of construction at Gouda, calculated at 200,000 fl. .	1,289,167 =	107,430
2. Enclosure, embankment, and canal, .	1,988,257 =	165,689
3. Expropriation, . . .	684,514 =	57,042
4. The three steam engines for the drainage of the lake, with the cost of repairs, coals, and wages, until December, 1855,	2,299,523 =	191,627
5. Works in behalf of the navigation—viz: the towing-path along the *Spaarne* and the enclosure canal, with the bridges, improvements of some existing canals, &c., .	133,288 =	11,107
6. Works for the defence of the capital by inundation, .	275,921 =	22,993
7. Works relative to the division of the grounds—viz: the construction of drains, roads, bridges, &c., . .	1,261,199 =	105,100
8. Entertaining and repairs of the different works during the drainage, until the end of 1855, . .	363,751 =	30,314
9. Direction, office expenses, policy, experiments, &c.,	639,477 =	53,289
10. Expenses not provided for, . .	46,247 =	3,854

	Florins.	£.
Whereto are to be added 220,000 fl., which were expended for repairing the drains and enclosure of canal, which, in the winter from 1854-55, had suffered considerably by the banks not then being thoroughly settled, and being soaked, the alternate frost and damp weather, caused a slipping and filling of the drains and canals, . .	220,000 =	18,333
	9,201,344 =	766,778

The profits may be calculated as follow :—

	Florins.	£.
Sale of the grounds, . . .	7,972,400 =	664,366
Profits of a fund formed by utilizing the money not directly required, and the profits of the grass on the banks being sold until 1853, ...	932,236 =	77,686
Profits of the grass during 1854, as also from the taxes for keeping the land dry, amounting to 7 fl. per hectare (4*s.* 8*d* per acre), ...	61,647 =	5,137
The same for 1855, ...	87,461 =	7,288
Profits from the sale of 32 hectares for building villages, valued at	70,000 =	5,833
Profits of 42 hectares, near the engine the *Cruquius*, valued at	14,700 =	2,225
	9,138,444 =	761,535

This difference between outlay and profits is very trifling, but to it must be added the rent of the first negotiated capital, amounting together to about three and a half million florins (£29,000); so that the total cost for which the Haarlem Mere has been drained, with all the additional works enumerated above, and their repairs, together with the discharging of the superfluous water, during three consecutive years, notwithstanding the drainage has lasted much longer than was expected, has been performed for this comparatively small sum. This sum will be diminished afterwards, when the lands, which, during the first twenty years are free, begin to pay taxes.

Thus, by this extraordinary work—which may be considered as being the greatest of the kind ever performed—a surface of water, which every year invaded a greater portion of its banks, and grew every year more dangerous for the great and rich towns which are situated in its vicinity, has been transformed into valuable crop-growing land, which every year improves in quality and gradually realizes a higher price; so that whilst 18,000 hectares more are now cultivated in the richest part of the Netherlands, adding so much more to the public wealth, a permanent barrier has been formed against the encroachments of the North Sea upon an enormous tract of lowlands situated between the North Sea and the Zeuider Zee. It is attributable to the uncommon skill and energy of the engineers and the Commissioners that this work has been finished with such a success, and they have given to the world an example of what may be done in this way, and how it may be performed in a comparatively short time with but a small amount of capital when judiciously expended. The drainage of the Haarlem Mere is a triumph of science over nature, of which Holland may forever be proud.

Deventer, Holland, February, 1856. H. C. Bosscha, C. E.

AMERICAN PATENTS.

List of American Patents which issued from November 4th, to December 2d, 1856, (inclusive,) with Exemplifications.

NOVEMBER 4.

1. For *Improved Machinery for Operating the Pawl Cases of a Ship's Windlass;* Christopher Amazeen, New Castle, New Hampshire.

Claim.—"My arrangement of the brake levers, connexion lever, vibratory posts, and two pawl cases, as applied to a post and windlass barrel."

2. For an *Improvement in Cutting Metals;* Robert Anderson, U. S. Army, and Aaron H. Vancleve, Trenton, New Jersey.

Claim.—"The use of the parallel table, revolving table, and traversing table, in connexion with machinery for punching and shearing metals, when the said tables are constructed and operated for cutting and punching straight, curved, or irregular forms in metal."

3. For an *Improved Instrument called an Equatorial Sextant;* William A. Burt, Mt. Vernon, Michigan.

Claim.—"Combining with the common sextant, equatorial and horizontal movements, for the purpose of obtaining latitude, time, azimuth, altitude, and declination, which are read from the instrument without computation. Also, combining the limb which moves over the face of the hour circle with the limbs, by means of the slotted arc, (or equivalent thereof,) and movable bearing and vertical spindle. Also, combining the latitude circle with the limb, by means of the limb, (having its centre of motion on the line,) the arc and bearing, and vertical spindle."

4. For an *Improvement in Odometres;* Albert Carter, Forestville, Conn.

Claim.—"The bearing ring, the catch spring, and the set screws, on which the case containing the movements turn by the action of the carriage wheel, and produces the result of indicating the distance traveled."

5. For an *Improvement in Railroad Car Brake;* William G. Creamer, City of N. Y.

Claim.—"The attachment of a reserve power for applying the brakes in sudden emergencies connected to, and identified with the present brake shaft as used in eight wheel platform cars, and operating in combination with the common bell or signal cord of the train. Also, in combination with the cross bar, with the spring drum, and circles of ratchet teeth, operating in connexion with the vertical brake shaft, or the equivalent of a loose pulley with a double circle of ratchet teeth arranged in the same way, but actuated by a weight or spring. Also, the combination of jointed pawls and disconnecting lever, with the drum for retaining and disengaging the reserved power when required, while the brakes are being operated by hand if necessary."

6. For an *Improvement in Railroad Station Indicators;* Edwin A. Davis, Crawfordville, Indiana.

Claim.—"The bar connected with the pawls and operated by the lever and crank."

7. For an *Improvement in Rocking Chairs;* Martin Eberhard, Philadelphia, Penna.

Claim.—"1st, The lever, the link and lever, in combination with the seat and adjustable foot rest. 2d, The treadle, its arm and link, in combination with the frame and foot rest. 3d, The crank shaft, the lever and link, in combination with the cross piece and frame."

8. For an *Improvement in Spading Machines;* Ormrod C. Evans, Stantown, Ohio.

Claim.—"The combination of a series of forks or spade blades, with an endless chain, and with a drum and rollers, arranged in such order upon a carriage, that by the progressive onward motion of the machine, the said spades or forks will at first be forced by a direct or nearly direct thrust into the ground, and afterward in the act of being lifted by the chain out of the ground, shall be made to turn at such short angle with the surface, as will cause the breaking and upheaving of the ground."

9. For an *Improvement in Machines for Husking Corn;* Harlan P. Gerrish, Boscawen, New Hampshire.

Claim.—"The use of the hooks, or their mechanical equivalents, arranged and made to operate in connexion with two knives, for the purpose of cutting off the stalk of an ear of corn, and removing the husks therefrom. Also, making the cylinder with the depression."

10. For an *Improvement in Automatic Musical Instruments;* Hiram Groves, City of New York.

Claim.—"1st, Constructing the barrel of automatic musical instruments of a prismatical form, and by leaving spaces between the bars or rails covering it. 2d, Notching the rails or bars of an organ barrel, and securing in the said rails a wire. 3d, Constructing the tones of automatic musical instruments of metallic segmental plates."

11. For an *Improved Cowl or Draft Accelerator for Steamers;* Peter C. Guion, Cincinnati, Ohio.

Claim.—"The combination of the several devices, surfaces or parts constructively."

12. For an *Improvement in Railroad Car Brakes;* Dennis Harrigan, Winchester, Massachusetts.

Claim.—"The compensation rods, in combination with the levers, or their equivalents."

13. For an *Improvement in Machines for Making Rope;* John Harris, Hoosick Falls, New York.

Claim.—"The method of driving the flyers by arranging them radially to the main or laying spindle, and providing them with rings, or wheels, or their equivalents, to roll in contact with a stationary table, when rotary motion is given to the main or laying spindle, said rings being adjustable to bring them nearer to or further from the centre of the main or laying spindle, for the purpose of varying the speed."

14. For an *Improved Catch for India Rubber Shoes;* Nathaniel Hayward, Colchester, Connecticut.

Claim.—"The use of a steel, rubber, or other kind of spring catch of any proper shape in the heel of an india rubber overshoe or clog, having a projection or lip extending out horizontally, or through the quarter as specified, whereby the overshoe is prevented from slipping at the heel, and is susceptible of being disengaged from the under boot or shoe without using the hand."

15. For an *Improved Fishing Implement;* Elmore Horbon, Bristol, Connecticut.

Claim.—"The spear cross bar notched at each end, in combination with the spring jaws."

16. For an *Improvement in Looms;* Lucius J. Knowles, Warren, Mass.

Claim.—"The combination of a single picker staff, pickers, and boxes, wherein there is a separate picker for each box of the series, and all such pickers are successively moved towards and operated by such single picker staff, during the operation of weaving with the shuttles of the said series of boxes. Also, the improvement in the picker staff when applied to operate a series of pickers, arranged in a set of shuttle boxes as described, the improvement consisting in the bend or recess applied to the picker staff, so as to enable it while operating a picker, to pass by another picker under the former, and not move the said other picker in its box. Also, making the picker staff with a bend or recess, or its equivalent, so as to enable it while operating a picker, to pass by another picker, and not move the same in its box."

17. For an *Improvement in Automatic Rakes for Reapers;* Pells Manny, Waddam's Grove, Illinois.

Claim.—"Pivoting the rake for curvilinear play over the platform, to the up and down moving lever or supporting beam, and arranged to operate together and separately at intervals, in relation to the platform and each other."

18. For an *Improved Burglar's Alarm;* William McClachlan, Assignor to Robert Livingston, City of New York.

Claim.—"The application of a portable alarm (of any construction) to the key, so that the key being in the lock in one position, cannot be interfered with or the position changed without indicating the same by causing an alarm to be given."

19. For an *Improved Lubricator;* James F. Monroe, Fitchburgh, Mass.

Claim.—"The plate and plug, as arranged and combined with each other, and with the lubricating cup."

20. For an *Improved Spring Frame for Packages;* Henry B. Osgood, Dorchester, Massachusetts.

Claim.—"The arrangement of the protector frame, in relation to the box or other receptacle, and its combination therewith, by means of the elastic fastenings, or their equivalent."

21. For an *Improved Joint for Uniting a Mortising Chisel to its Mandrel;* Joseph R. Perry, Port Clinton, Pennsylvania.

Claim.—"Securing the revolving chisel socket to the cross-head or cap, by grooving both, and filling the annular space thus created with a metallic composition."

22. For an *Improvement in Trowels;* L. D. Phillips, Chicago, Illinois.

Claim.—"1st, The open bottomed chamber provided with flanches or trowels. 2d, The adjustable gauges as applied to my trowel. 3d, The general arrangement of the follower and its appendages, viz: springs, guide or brace, and handle."

23. For an *Improvement in Cotton Gins;* Wilson A. Purdom, Jackson, Miss.

Claim.—"1st, Giving to the cotton to be ginned within the feed box, and before the saws, a reciprocating motion by means of the corrugated cylinder, or a modification of such cylinder and the corrugated apron, or either of them separately, or their equivalents, so that the cotton will pass back and forth slowly in bulk, or nearly so, before the saws, thus presenting a fresh surface to the action of the saws, throughout the entire length of the saw cylinder, without having any of the saws idle, and without the accumulation of seed at one end of the box, or the banking up of the cotton at either end. 2d, The said cylinder or its equivalent, whether it is placed within or outside of the cotton roll, and whether it is permanently attached to the apron or not, also whether it revolves or not, or whether that revolution is continuous or intermittent. 3d, The corrugated apron, or its equivalent, whether it is operated conjointly with the said cylinder or not."

24. For an *Improvement in Machines for Husking Corn;* Joshua Perkins, West Killingley, Connecticut.

Claim.—"The improvement of so operating the two cutters or chisels, that during their descent into the stalk of the cob, they may pass into it in contact with each other, so as to pierce but one hole, and thereafter receive a lateral motion simultaneously in opposite directions, so that while one chisel or cutter is made to discharge the husk from the machine, the other is caused to discharge the ear therefrom."

25. For an *Improvement in Chain Pumps;* John Robingson, New Brighton, Penna.

Claim.—"Providing the wheel, having its buckets and chains arranged as described, with a partition forming troughs, and tilting stops or bars arranged relatively to each other, and rotating together with the wheel and its buckets for operating together."

26. For an *Improvement in Hay Rakes;* Thomas R. Roach, West Needham, Mass.

Claim.—"The springs above and below the teeth."

27. For an *Improvement in Sewing Machines;* S. H. Roper, Roxbury, Mass.

Claim.—"1st, A thread guide, which guides the thread into the eye of the needle, by means of the projection, and the thread holder forming a thread clamp, and griping and holding the thread between them, while the thread guide with its clamp revolves until the thread is wrapped partly round it and stretched across the aperture therein. And, then also, by means of the thread guide with the thread thus held, moving laterally, until in this manner, and by means of these rotary and lateral motions, the thread is effectually guided into the eye of the needle. 2d, The working of eyelet holes in cloth or other material, by means of a rotary feed motion combined with the slotted tube and two needles."

28. For an *Improved Method of Starting and Stopping Water Wheels;* David M. Tyler, Lisle, Massachusetts.

Claim.—"The combination of the frame upon the main shaft, and the spring dog on the same, with the notched disk, and the rods leading to the swinging buckets, or their

equivalents, for effecting the opening of the issues and locking of the same. Also, the beveled disk, in combination with the studs of the dog, or their equivalents, arranged and operating for permitting the water in the wheel to close the issues."

29. For an *Improvement in Throstle Spinning Machines;* Joel Smith, Northbridge, Massachusetts.

Claim.—"Regulating the twist of the yarn in ring spinning machines, by communicating a gradually accelerated motion, (proportionate to the gradually increasing diameter of the bobbins) to the rolls which give out the yarn to the bobbins."

30. For an *Improvement in Weaving Long Warps;* John C. Smith, New Hartford, Connecticut.

Claim.—"A box, in combination with the arrangement for dispensing with the warp beam, for the purpose of laying the warp in a regular smooth succession of layers evenly, that the box may give out the warp free from twists and tangles."

31. For an *Improvement in Sewing Machines;* Isaac M. Singer, City of New York.

Claim.—"Operating the needle to give it the required reciprocating motions, by a crank pin or roller on a rotating shaft, acting in a cam groove, whereby the required motions are imparted to the needle with much less extent of motion of the crank pin or roller in the cam groove, and consequently less friction, than if the cam groove were on the shaft, and the pin or roller on the needle carrier. Also, projecting the operative part of the surface of the feeding apparatus through the surface of the table, so that such feeding surface may act on a portion of the under surface of the material to be sewed, to give the required feeding motion to space the stitches, while the other portion of the said material slide on the table, which answers the purpose of stripping the said material from the feeding surface, and to cover and protect the mechanism which operates the feeder. Also, imparting the feeding motion to the feeder, to present the material to be sewed to the action of the needle for spacing the stitches, by griping the periphery thereof, or any equivalent therefor, by a griping lever in contradistinction to the action of a pawl or hand catching on to ratchet teeth, whereby the extent of feeding motion may be adjusted and varied to any degree, instead of being restricted by the size of ratchet teeth, and whereby also, I avoid the wear and liability to derangement incident to the use of a ratchet motion. Also, in combination with the feeder attaching the presser, for controlling the material to be sewed, and holding it to the surface of the feeder to a slide, or its equivalent therefor, so that the plane of its under surface shall always bear the same relations to the plane of the table in a line at or nearly at right angles to the line of the seam, whether the material to be sewed be thick or thin."

32. For an *Improved Apparatus for Heating or Cooking by Gas;* William F. Shaw, Boston, Massachusetts.

Claim.—"Combining with the wire gauze or perforated tube, and the air and gas burner, an air guide or concentrator applied thereto."

33. For an *Improvement in Stirrups for Riding Saddles;* Richard Trussell, Brooklyn, New York.

Claim.—"The attachment of the foot piece to the bow of the stirrup by a shaft, or other connexion of a similar character, furnished with a spring."

34. For an *Improved Machine for Sawing Marble and Stone;* George J. Wardwell, Hartley, Canada.

Claim.—"Suspending the swinging saw frame from levers, when arranged as described, and constructed with or without the circular bearing surface, resting on the friction roller or rollers, in the end of the vertical lever or levers attached to, and swinging with, the swinging saw frame."

35. For *Improved Self-Acting Head and Tail Blocks for Sawing Mills;* A. S. Walbridge, Burlington, Vermont; patented in Canada, July 28, 1853.

Claim.—"The combination and arrangement of the T shaped carriage blocks, connecting rack, and setting off shaft, whereby a self-operating carriage of any desired length or compactness is produced. Also, the self-setting off device, composed essentially of the ratchet, disks, adjusting stop, and stationary cam."

36. For an *Improved Drain Tile Machine;* Thomas Maycock, Assignor to self and Henry Rice, Buffalo, New York.

Claim.—"The combination of the annular ring, with the plunger, the latter having a smaller diameter than the ring and cylinder."

37. For an *Improvement in Fabric for Underlaying Carpets;* William S. Pratt, Assignor to J. S. C. Thursby, Brooklyn, New York.

Claim.—"The cellular paper or paper board, for the purpose of underlaying carpets on floors."

38. For an *Improvement in Power Looms;* Alexander Smith and Halcyon Skinner, West Farms, New York.

Claim.—"1st, Mounting the yarns for formimg the ranges of tufts in parcels, on a series of spools or equivalents therefor, in the order required for producing the design or pattern required, so that each spool, or the equivalent therefor, may be brought in succession to the required position for each range of tufts. 2d, The mode of operation by which the spool frame required at each operation is brought down in close proximity with the tufting warps, and then carried out of the way of the lay when performing its operations. 3d, The mode of operation by which the tufts of yarn are introduced and applied to the tufting warps. 4th, The mode of operation by which the tufts are cut off from the yarns after they have been introduced and applied to the warps. 5th, The mode of operation, by which the tufts are carried to the required place in the fabric, by the combined action of the reed and plate, or any equivalent therefor. 6th, And in combination with the several modes of operation by which the tufts are introduced, the employment of the heddle motion, for binding and holding the said tufts by the warp threads."

39. For an *Improved Shutter Fastener;* David M. Lawrence, Cincinnati, Ohio.

Claim.—"A lock plate, when constructed with a semi-circular flanch, having a series of notches cut therein, in combination with the spring stop and hinge."

40. For an *Improvement in Crushing Rollers for Ores, &c.;* William H. Plumb, City of New York.

Claim.—"The construction, combination, and arrangement of the stationary and movable rollers, adjusted to the work to be done."

41. For an *Improvement in Cider Mills;* Benjamin Mackerly, New Petersburgh, O.

Claim.—"The combined use of flat sided saw edged teeth upon the cylinder and within the concave."

42. For an *Improved Tool for Tenoning, &c.;* Alfred Tippet, Washington, D. C.

Claim.—"So making of the chisels adjustable in the stock, as that they may be made to cut also a dove-tail tenon with the same tool, and without reversing the same, and so that said tool may be used in any ordinary mortising machine, and thus avoid the expense of two machines."

NOVEMBER 11.

43. For an *Improvement in Bumper Brakes for Railroad Cars;* Francis Armstrong, New Orleans, Louisiana.

Claim.—"The employment of the yielding force, made by the pull on the cars, to adjust the apparatus, and place it in position, that the force acting by the cars coming in contact with each other, will secure that force to act on the brakes, and close them on the wheels, and the force made by the pull on the cars when allowed to re-act, reversing the position of the apparatus, in the placing it so that the pressure of the cars acting against each other, can operate on the apparatus, and have no action on the brakes."

44. For an *Improved Anti-frost Faucet;* Frederick H. Bartholomew, City of N. York.

Claim.—"The application of a waste way to draw cocks."

45. For an *Improved Steam Drag;* George Bradley, Paterson, New Jersey.

Claim.—"The arranging of the driving wheels of a steam carriage in a truck frame that can turn independent of the engine frame, and so that the engine frame shall follow or be drawn by the truck frame, instead of the latter being controlled by the former, as

has heretofore been done. Also, transmitting the power of the engine to the driving-wheels in the truck frame, so arranged through the swiveling point or axis of the truck frame, as that there shall be no cramping or twisting of the frames or connecting rods."

46. For an *Improvement in Steering Apparatus for Ships;* Thomas Carr, Liverpool, England.

Claim.—"The application to the ordinary steering apparatus of vessels, of a crank, or its mechanical equivalent, the eccentric working, in combination with an entire pulley or its segment, a quadrant on a vertical axis, the whole being interposed as a medium of communication between the wheel ropes or chains and the tiller."

47. For an *Improvement in Draining Machines;* John Cole and A. Little O. Wall, De Witt, Illinois.

Claim.—"1st, The combination of the brace coulter, and rotating coulter, with the mole. 2d, Constructing the mole in sections flexibly connected together. 3d, Constructing the mole with a fin or knife on its sole, to make a deep furrow in the bottom of the drain to facilitate the entrance of the water from the adjacent soil."

48. For an *Improvement in Fastening Door Knob Spindles;* Almon Cooley, Assignor to Roderick Terry and A. Cooley, Hartford, Connecticut.

Claim.—"The conical slide, when combined with the spindle and knob."

49. For an *Improved Door Fastener;* Legrand Crofoot, Syracuse, New York.

Claim.—"Combining the two plates with the spring bolt of the plate and the eye hook of the plate."

50. For an *Improved Diaphragm Fluid Metre;* J. Henry Darlington and Wm. Piper, City of New York.

Claim.—"The particular arrangements of the elements or devices."

51. For a *Sleeve Fastener;* John P. Derby, Cavendish, Vermont.

Claim.—"Arranging and combining with a face plate by means of a post or stem, a cross-bar or plate, which, with proper construction, admits of the insertion of a stem or stems into the holes of a wristband or cuff, and is then secured in place by means of slots in the plate that revolves until the stems are entered therein. Also, the spring which serves to keep said stems in place in the slots, and which prevents the face plate from being turned until its force is overcome. Also, combining with the stem of the face plate, and the cross-bar, two sets of cams, whereby the distance between the stems of cross-bar and face plate can be graduated to receive the wrist-band at pleasure, and whereby the distance that the face plate and cross-bar traverse in opposite directions may also be controlled, the whole making a perfect and safe fastener."

52. For a *Sugar Draining Apparatus;* Gustavus Fincken, Brooklyn, New York.

Claim.—"The employment for the reception of the moulds of a wheel carriage, composed of a box or vessel, with seats to receive the moulds, and a frame to keep them upright, and with stoppers so applied within the box or vessel, as to enable several to be inserted in, or withdrawn from, their respective moulds simultaneously by a crank, or its equivalent, at one end or side of the carriage."

53. For an *Improvement in Machines for Harvesting Grain;* George F. Foote, Buffalo, New York.

Claim.—"The peculiarly constructed scroll cylinder, in combination with the cylinder case, and the gathering wheels, when the same are constructed and arranged to operate in relation to each other and the main frame."

54. For an *Improved Spring Holder for Slat Blinds;* William L. Gallaudet, City of New York.

Claim.—"The combination of the peculiarly shaped spring, with the rod and with the lower rail."

55. For an *Improvement in Water Gauges for Steam Boilers;* John C. Harris, Savannah, Georgia.

Claim.—"The arrangement of the float chamber, the stop-cocks, and the blow-off cocks, to adapt the gauge to the employment of oil, interposed between the float and the water to carry the float."

56. For an *Improved Method of Regulating the Draft of House Furnaces;* Samuel L. Hay, Reading, and Henry B. Osgood, Dorchester, Massachusetts.

Claim.—"The compound valve with the spring, or its equivalent, and equipoise, in combination with the pipe."

57. For a *Candle Mould Machine;* August Hengstenberg, Muscatine, Iowa.

Claim.—"The combination of the spools as constructed in my machine, with their gearing and locking. Also, the securing of the cutter by means of the layer."

58. For an *Improvement in the Cutting Apparatus of Grain and Grass Harvesters;* Moses G. Hubbard, Penn Yan, New York.

Claim.—"The combination of a single cutter with a double cutter, and made to reciprocate in directions opposite to each other."

59. For an *Improvement in Forks for Handling Heated Plates;* G. W. Hyatt, Auburn, New York.

Claim.—"The clamp or spring, for the purpose of supporting the tines, and also to allow them to be adjusted to suit articles of different diameters."

60. For an *Improved Method of Ventilating Ships, &c.;* Rudolph Knecht, City of N. Y.

Claim.—"The combination and arrangement of two sets of wings on one shaft, acting simultaneously, so that while one is expelling the foul air, the other will draw in fresh air."

61. For an *Improvement in Wagons;* Henry Kruse, New Orleans, Louisiana.

Claim.—"The application to wagons of wheels made buoyant by the use of disks that will cause the wagon to be supported in water from such buoyancy; with the application of propelling blades on said wheels, to cause the wheels to be available in propelling the wagon in water, and the same wheels, by removing the propelling blades, can change the wheel so that they are available in their uses in the transporting of substances on land similar to common wheels of wagons."

62. For an *Improved Waste Valve for Hydrants;* Robert Lawson, St. Louis, Mo.

Claim.—"The interior arrangement and combination of water valve and air chamber. Also, the peculiar combination of an air chamber with the waste valve."

63. For an *Improved Method of Hanging Reciprocating Saws;* George D. Lund, Yonkers, New York.

Claim.—"Placing or fitting the rod or shaft, to which the lower strap or socket is attached, loosely in the slides."

64. For an *Improved Method of Preparing Ratan for Umbrellas;* James W. Martin, Philadelphia, Pennsylvania.

Claim.—"The combined devices for forming and tipping the ratan or whalebone for umbrella ribs."

65. For an *Improvement in Cutting Files;* Charles Miller, City of New York.

Claim.—"Fitting the chisel to work in a stock which rests upon the file blank itself, or on a pattern of similar form moving with it throughout the whole length of the movement of the blank under the chisel, and serves as a stop to the chisel."

66. For an *Improvement in Clothes Dryers;* Samuel Morrill, Andover, N. H.

Claim.—"Arranging the ratchet on the under side of the reel, in combination with the pawl and lever, in such a manner that the pawl and ratchet are brought into play when the reel is tilted, but thrown out of play when in its horizontal position."

67. For a *Medical Respirator;* Edwin M. Murphy, Lexington, Illinois.

Claim.—"The combination with the usual medical inhaler of a fan, to be revolved by the act of inhalation."

68. For an *Improvement in Machines for Slicing Apples;* Ephraim L. Pratt, of Philadelphia, Pennsylvania.

Claim.—"Attaching the knives to a reciprocating piece, by means of pins or axes on which they can so rotate, in combination with the straight rod or guide, for the purpose of causing the knives to descend through the apple in lines parallel to its axis."

69. For an *Improvement in Washing Machines;* Ira Reynolds, Republic, Ohio.

Claim.—"The arrangement and combination in washing machines, of the reciprocating pulleys, springs, and plungers."

70. For a *Process for Cleaning India Rubber;* T. Sault, Seymour, Connecticut.

Claim.—"The cleaning of india rubber by means of the serrated sided teeth, and stationary serrated sided bars, constructed and arranged to operate in combination with each other."

71. For an *Improvement in Breech-Loading Fire Arms;* Gustave Scharffe, City of New York.

Claim.—"1st, The manner of cocking the hammer by the opening of the breech. 2d, The arrangement and construction of the hammer. 3d, Screwing the breech cap, either upon or into the gun barrel, said breech cap being provided with a hole corresponding with a hole in the gun barrel, by the unscrewing of which said breech cap, the hammer is cocked, and both holes are brought above each other so as to admit the cartridge, while, by the screwing up of said breech cap, the hole in the gun barrel is closed up again."

72. For an *Arrangement of Means for Heating Feed-water of Locomotive Engines;* John R. Sees, City of New York.

Claim.—"The construction of the duplicate cylindrical coils, and their arrangement in relation to the smoke box, the exhaust pipes, the tubes, and the base of a smoke stack of a locomotive boiler."

73. For an *Improvement in Breech-Loading Guns;* Christian Sharps, Philadelphia, Pennsylvania.

Claim.—"The combination and arrangement of a spoon-formed cartridge piercer. with the turning breech pin of a breech loading fire arm, whereby the powder is more effectually worked into the channel leading to the primer, by the operation of locking the breech pin in its place. Also, the combination of a removable brush and elastic packing ring with the breech of a fire arm."

74. For a *Gas Regulator;* W. G. Sterling, Bridgeport, Connecticut.

Claim.—"The vibrating balance, with the partition, forming two chambers, and extending into said balance, which is so adjusted that it vibrates in the two chambers, and is connected with a valve in any suitable form."

75. For an *Improvement in Mill Stone Dress;* Thomas B, Stout, Keyport, N. J.

Claim.—"The combined arrangement of furrows upon the grinding plates, viz: the inner furrows, having their abrupt edges on the two grinders, meeting by the revolution of the runner deep at the central ends, but running out to the surface at the outer ends, while the peripheral furrows are arranged oblique to the inner furrows, their edges inclined in the opposite direction, and having a considerable proportion of plane surface between them."

76. For a *Copper Ring for Gas Retort Fastening;* William H. St. John, City of N. Y.

Claim.—"1st, The tightening with copper, of the joints of doors of gas retort heads, when the said joint is effected by the otherwise usual groove inserted in the flanch of the mouth piece, to meet a corresponding projection on the door. Also, the placing a hot air chamber beneath the mouth piece, to consume the tar and oil collecting on the bottom of the latter."

77. For an *Improved Projectile for Fire Arms;* William Taggart, Haverhill, Mass.

Claim.—"The spiral partition. Also, the wings."

78. For an *Improved Weather Strip for Doors;* Reuben Wight, Westfield, N. Y.

Claim.—"The adjustable weather strip, operated by the segment lever, in connexion with the movable button and the cams."

79. For an *Improvement in Machines for Cutting Vegetables;* Jacob Geiss and Jacob Brosius, Belleville, Illinois.

Claim.—"The cone, provided with slots and secured upon the shaft, in combination with the knives attached to the arms and disk."

80. For an *Improvement in Harvesters;* Alvin Bullock, Busti, New York.

Claim.—"Operating the sickle bar by means of the right angled lever on the shaft, in combination with the lever, bar, and flanch, when the same are constructed and arranged to operate in relation to the main frame, drive-wheel, and adjustable finger bar."

81. For an *Improvement in Machines for Paring Apples, Potatoes, &c.;* Ephraim L. Pratt, Philadelphia, Penna., Assignor to Leonard Harrington, Worcester, Mass.

Claim.—"1st, Moving the apple, potato, or other object, in a direct line past the knife, or the knife past the object, during the revolution of said apple, potato, or other object, by means of the screw shaft, and cogged rack, whereby the operation of paring is performed by the turning of the screw shaft, without any other movement of the knife than that occasioned by the curvature, size, and inequality of the surface or form of the article being pared, to which the said knife is accommodated by the action of the spring. 2d, The peculiar form of the knife—that is to say, shaping the portion nearest the shaft of the form of a segment of a circle of a given radius, and the remaining portion farthest from the shaft of such curvature as will form a segment of a cycloid of a circle, combined with the first portion, and correspond, or nearly so, with the spiral curve of the screw, when the end of the apple, potato, or other object, is being pared, in such a manner as to enable its edge to assume at all points of contact with the potato, or other object, a convex curve, the reverse of the convex part of said apple, potato, or other object, with which it is in contact, and thereby enable its end and every inequality of its surface to be pared by thus accommodating the edge of the knife to these parts."

82. For an *Improvement in Excavators;* John F. Willey, Fredonia, Assignor to self, B. F. Merrill, and Thomas Phillips, Cassadaga, New York.

Claim.—"Forming the scoop of two parts connected by joints or links, the bottom of the scoop being formed of slots which are allowed to turn, the scoop being suspended to the cart."

83. For an *Improvement in the Manufacture of Iron and Steel;* Henry Bessemer, London, England; patented in England, February 12, 1856.

Claim.—"The conversion of molten crude iron, or of re-melted pig or finery iron into steel, or into malleable iron, without the use of fuel for re-heating or continuing to heat the crude molten metal, such conversion being effected by forcing into and among the particles of a mass of molten iron, currents of air or gaseous matter, containing or capable of evolving sufficient oxygen to keep up the combustion of the carbon contained in the iron, till the conversion is accomplished."

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84. For an *Improvement in Smelting Iron Ore;* Henry Bessemer, London, England; patented in England, August 25th, 1856.

Claim.—"The obtaining from a charge of ore in a furnace, viz: by means of molten iron underlying such charge, and by air, oxygen, steam, or a gas containing oxygen forced into the molten iron, to such extent as to effect the reduction of the charge, or the abstraction of the metal therefrom, without the employment of ordinary carbonaceous fuel."

85. For an *Improvement in Attaching Centre Boards to Vessels;* George S. Burrows, Mystic River, Connecticut.

Claim.—"The hanging of the centre board to a movable post, or other sliding piece of similar character, which admits of its being easily and readily removed from the trunk for repairs or any other purpose."

86. For an *Improvement in Machinery for Polishing Glass;* Phineas Burgess, City of New York.

Claim.—"The employment and use of grooves arranged eccentrically upon the polishing bed, in combination with the cranes and frames."

87. For an *Improvement in Machines for Sawing Marble;* Wm. Dobson Gallaher, Bensalem Township, Pennsylvania.

Claim.—"The frames, and the mechanism connected therewith, when constructed and arranged to operate in relation to each other."

88. For an *Improved Burglar Proof Safe;* Richard G. Holmes and W. H. Butler, City of New York.

Claim.—"The loose fitting pieces, applied to be received partly in a rebate in the door, and partly in a groove in the door frame."

89. For an *Improvement in Machines for Cleaning Grain;* Chase B. Horton, Elmira, New York.

Claim.—"1st, The double-acting V shaped distributer, in combination with the concentric ring guard, for the purpose of distributing the grain to the periphery of the cylinder while falling, and preventing its return in the blast. 2d, The construction and arrangement of the double blast head. 3d, The combination of the spring partition with the spring valve, so arranged that the expansion of the blast tube by means of said partition shall cause the valve to open, and thereby admit air above the mouth of the tube."

90. For an *Improved Spring Latch and Lock;* William A. Ives, New Haven, Conn.

Claim.—"The securing the bolt on the inside, when the same key serves to turn back the bolt, and also to hold it back when desired, and when the said key, or any additional key used, is so constructed and arranged that it will swing or turn entirely within the tube or cylinder."

91. For *Lee-boards for Vessels;* Augustus Jouan, San Francisco, California.

Claim.—"The elastic metal blade lee-boards, which I call ship-fins, to the sides of ships, vessels, and boats, in a position nearly vertical."

92. For an *Improvement in Propeller Shafts;* Augustus Jouan, San Francisco, Cal.

Claim.—"A propeller shaft, which in its construction is circular, conical, and angular, with these three conditions combined or otherwise, and to be applied vertically."

93. For an *Improvement in Combined Steam Boilers and Kettles;* Allen Lapham, Assignor to self and Stephen Wilkes, Brooklyn, New York.

Claim.—"The use of the kettle, surrounded by steam, in connexion with the boiler, the reservoirs, with valves (or their equivalents), on the upper and lower sider, and the induction pipe."

94. For an *Improvement in Bedstead Fastenings;* Spencer Lewis, Tiffin, Ohio.

Claim.—"The inclined pin passing through post and tenon, in combination with the segmental guard and stud."

95. For an *Improvement in Melodeons;* La Fayette Louis, Boston, Mass.

Claim.—"1st, The use of a long valve or valves, placed over the reeds and under the swell, and vibrated in such a manner by any proper arrangement of mechanical devices as to break and vary the force of the air passing through the reeds, thereby producing a sound similar to the 'tremolo' in the human voice. 2d, Actuating the 'tremolo' valves, so as to impart to them a vibratory movement by means of the fan wheel and crank, or their equivalents, made to revolve by a current of air passing through the box to the bellows."

96. For an *Improved Stave Jointer;* Barnet McKeage, Accotink, Virginia.

Claim.—"The device for automatically jointing staves of different widths to the proper bulge, consisting essentially of the pattern plates and the guiding slots, or their equivalents, respectively set at such different angles as to separate the two ends of said pattern plates unequally and exactly in proportion to the bulge required."

97. For an *Improvement in Cotton Gins;* C. A. McPhetridge, St. Louis, Missouri.

Claim.—"1st, The friction spools, arranged in combination with the saw. 2d, The breast plate, in combination with the spools."

98. For an *Improved Binder for Grain Harvesters;* C. A. McPhetridge, St. Louis, Missouri; ante-dated, October 25th, 1856.

Claim.—"The combination of the reciprocating arm, with spring pliers attached, with stationary arm, revolving twister, cutting plate, friction brake spring, and removable plate, when the same are constructed and arranged to operate in relation to each other and the main frame and driving wheel, for the purpose of binding grain from a continuous coil of wire."

99. The notice of this patent is postponed for the present, at the request of the patentee.

100. For an *Improvement in Lubricating Car Axle and other Journals;* Pierre E. Proust, Orleans, France; patented in France, April 15th, 1853.

Claim.—"The application to greasing or lubricating apparatus of axles, shafts, and other rotating portions of carriages and of machinery, of an air tight reservoir containing water, which being heated by the friction of the rotating portion, is caused to pass through a siphon into the box containing the lubricating matter, and there to mix with it."

101. For an *Improved Bleaching Process;* Julius A. Roth, Philadelphia, Penna.

Claim.—"Aiding the action of the usual bleaching agents, by the application of atmospheric air."

102 For an *Improved Boring and Mortising Machine;* G. H. Stevens, Lowell, Wis.

Claim.—"Attaching the auger or bit, chisel, and hammer, to the sliding frame, and operating the auger or bit, hammer, and frame."

103. For a *Tail-piece for Violins, &c.;* Charles M. Zimmerman, Philadelphia, Penna.

Claim.—"1st, The tail-piece, with its recess and loose cover. 2d, The employment of the pins for securing the strings by a single fold to the tail-piece."

104. For an *Improvement in Grain Separators and Conveyers;* Joseph Lyndall, Santa Clara, California, Assignor to Cyrus Roberts, Bellville, Illinois.

Claim.—"1st, Suspending the conveyer on vertical radius bars or pendulum bars, which swing it forward first in a nearly horizontal, and next in an upward direction, and then swing it back, first moving it suddenly downwards, and next horizontally or thereabouts, until it reaches the place whence it started. 2d, Swinging and rocking the conveyer on radius bars of unequal lengths, which raise its rear end somewhat further and faster than its front end. 3d, Arranging the head of the vibrating shaking fingers in a recess in the bottom of the conveyer. 4th, The combination of an adjustable bar or guide, with an arm projecting from the head of the vibrating fingers, so that the upward throw of the fingers may be varied while the limit of their descent remains unchanged. 5th, Constructing the screening apertures in the bottom of the conveyer, with channels on the front sides of the tops thereof, to facilitate the separation of the grain and chaff from the straw, and the passage of the straw through the conveyer."

105. For an *Improvement in Machines for Paring Apples;* Charles P. Carter, Ware, Assignor to Leonard Harrington, Worcester, Massachusetts.

Claim.—"The semi-cylindrical holder, for the purpose of holding and coring the apple. Also, the peculiar form and arrangement of the spring, for the purpose of throwing back the carriage, and operating with an equable pressure during the whole of the progress of the knife."

106. For an *Improved Device for Governing the Parallel Yielding of Lumber Feeding Rollers;* Josiah B. Pomroy, Chicago, Illinois.

Claim.—"The arrangement and combination of the parallel arms, central guiding rod and spring, in connexion with the yielding feeding rollers, mounted on sliding carriages."

107. For an *Improvement in Tailors' Pressing Machines;* C. W. Williams, Boston, Massachusetts.

Claim.—'Suspending the iron or goose from a convex disk, which turns freely upon a ball and socket joint, or its equivalent, and which forms a bearing for the lever to act against."

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108. For an *Improvement in Machines for Stuffing Horse Collars;* Joseph Albright, Greenville, Tennessee.

Claim.—"The intermittently revolving toothed feed wheels, when arranged at the back and on the outside of the hopper, in combination with the crooked fed straw retaining spaces, or chamber, at the bottom of the hopper, and extending backwards, the teeth of the wheels (which work from the outside at the rear into the hopper), urging the slip of the straw down the inclined rack or back of the hopper, and feeding it into the retaining spaces to wait the action of the plunger."

109. For an *Improved Lathe for Cutting Fluted Mouldings;* James Anderson, John McLaren and John Bryant, City of New York.

Claim.—"1st, The adjustable rotating cutters attached to shafts, which are fitted in frames, the frames being fitted and working in pendent guides attached to the adjustable block. 2d, Placing the leg between centres, which are attached to a swinging frame fitted on a reciprocating carriage; the leg being turned or rotated between its centres as the carriage moves by means of the inclined slot in the ledge or plate, and the lever and gearing."

110. For an *Improvement in Printing Presses;* F. L. Bailey, Boston, Mass.

Claim.—"The combination of the stationary bed with the revolving distributing cylinder, when the two are so placed within the circle of revolution of the ink rolls. Also, the impression lever, in combination with the connecting bar, when the two are so arranged that they may be disconnected at pleasure."

111. For an *Improvement on Fourneyron Turbine Wheel;* Stephen K. Baldwin, Gilford, New Hampshire.

Claim.—"The extending of the bucket of the Fourneyron turbine water wheel further inward towards the centre of the wheel (either on the radial lines, or on lines varying either side of the central point), and thence upward and outward, so as to receive the direct action of the propelling water against the extended bucket on the outside of the wheel, and above the Fourneyron turbine part."

112. For a *Process of Treating Feldspar for a Manure;* Charles Bickell, Baltimore, Maryland.

Claim.—"The decomposing of feldspar by heating it with lime and phosphate of lime, for the purpose of obtaining potash or soda either in the caustic or carbonated state, and for the purpose of obtaining a manure."

113. For an *Improved Alcohol Cooking Apparatus;* Thomas G. Clinton, Washington, District of Columbia.

Claim.—"An alcohol burner, arranged in its several parts, or in any equivalent manner, irrespective of the method by which alcohol is supplied to the chambers. Also, the internal pipe, or its equivelent, arranged in relation to the tube."

114. For an *Improvement in Boxes and Axles, Journals, &c.;* David Cumming, Sorrel Horse, Pennsylvania.

Claim.—"The V collar or bearing, running in a V groove, and the construction of the box in two separate parts with the oil receptacles."

115. For an *Improvement in Machines for Polishing Leather and Harness;* William Crane, Brooklyn, New York.

Claim.—"The suspended triangular swinging frame, having a socket or receiver attached at one end, and a pitman or connecting rod at the opposite end; the whole forming an equal balance, giving a steady motion to the machine in operation."

116. For an *Improvement in Curry Combs;* Evan L. Evans, Providence, R. I.

Claim.—"Constructing the curry comb with an elastic or flexible back, formed of india rubber, and securing the teeth permanently in the back by having the india rubber which encompasses the teeth project from the face of the back in the form of ridges, and cones projecting to the point of the teeth."

117. For an *Improvement in Backgammon and Checker Boards;* Edwin O. Goodwin, Bristol, Connecticut.

Claim.—"The construction of draught boards with the indentations on the face, the raised divisions in the backgammon part, and the drawers for the pieces, all in combination."

118. For an *Improvement in Manufacturing Cotton Yarns;* George G. Henry, Mobile, Alabama.

Claim.—"The combination of the gin and 'preparation,' that is to say, the arrangement of the cotton gin, in immediate connexion with, and to operate in combination with the spreader or lap machine of any desired construction, so that the gin and spreader combined, shall operate in a regular sequence with the carding and drawing, and other spinning machinery."

119. For an *Improvement in Lathes for Planing Metal;* William W. Hubbard, Boston, Massachusetts.

Claim.—"Arranging the tool carriages, slides, or supports, on the vertical sides of the frame or bed, in combination with arranging above such slides, and so as to project from the sides of the frame and over the slides, covers or guards, whereby the slides are protected from dust, chips, or other matters."

120. For an *Improvement in Stitches for Sewing Machines;* A. F. Johnson, Boston, Massachusetts.

Claim.—"Making a stitch of a single thread, by throwing a shuttle and thread through a loop formed from the shuttle thread, thereby tying or knotting each stitch for the purpose of uniting pieces of cloth or other material to be sewed."

121. For an *Improved Machine to Aid in Making Spokes by Hand;* Edward Julier, Sharon, Ohio.

Claim.—"The construction and arrangement of the pattern cam-gauge device, the jointed lever device, the collar shank, and spring pawl, when operated by the pedal, or its equivalent, together and with the stop or dog and ratchet. Also, the graduating straddle gauge, and hinged or jointed forming gauge rest, with the graduating set plate and yoke devices, with the knife shields or buffer heads."

122. For an *Improvement in Turning Circles for Carriages;* George Kenney, Milford, New Hampshire.

Claim.—"An annular box plate composed of two circles, one attached to the head block or rocker, and the other to the axle, and so constructed as to form a box for excluding dirt and grit from the bearing surfaces of the circular plates, in which box is inserted a washer of oiled leather, the box serving to exclude all dirt and grit from the bearing surfaces, and thereby preventing their rapid wear, and the leather washer preventing the squeaking noise and friction common to all other modes of connecting turning circles, and preventing the jar which would otherwise be occasioned by two metallic surfaces striking together. Also, combining with a 'circle,' a rubber or other elastic friction roll upon which the said circle turns, to lessen the friction and noise, and diminish the wear."

123. For an *Improved Machine for Turning Boot Legs;* M. C. Chamberlin and W. Filkins, Sheldon, New York.

Claim.—"The expansion tube, the rim follower, encircling said tube, the disk-plunger, provided with hooks, and operated inside of said tube, in combination with racks and pinion, for the purpose of imparting adverse longitudinal motion to said rim follower and disk plunger."

124. For an *Improvement in Fire Arms;* Alexander Le Mat, New Orleans, La.

Claim.—"The combination and arrangement of the hammer and finger with the mechanism, whereby the retrograde movement of the hammer, after the ignition of the primer, produces an automatic closing of the vent by the finger."

125. For an *Improvement in Traveling Trunks;* Samuel W. Phelps, Cincinnati, Ohio.

Claim.—"The arrangement of drawers, partitions, and side-lids or doors, for the combined purpose of security, orderly arrangement, and accessibility of all the contents in a traveling trunk."

126. For an *Improved Apparatus for Exhausting Air from and Hermetically Sealing Cans and Vessels;* Aurelius M. Purnell, Washington, D. C.

Claim.—"The apparatus."

127. For an *Improved Disk for Shelling Corn;* Jeremiah P. Smith, Hummelstown, Pennsylvania.

Claim.—"The annular concave shelling surface on the face of the shelling disk, when employed in combination with the other parts of the machine."

128. For an *Improvement in "Edge-keys," for Making and Polishing the Edges of Boot and Shoe Soles;* George C. Todd, Lynn, Massachusetts.

Claim.—"A turned or circular edge-key."

129. For an *Improved Gas Cock and Swinging Joint;* Charles F. Thieme, Philadelphia, Pennsylvania.

Claim.—"Making a swing joint for gas brackets, the same consisting of the tubular plug and its cap, with the leather washer and spring, or their equivalents, in combination with the barrel, so as to produce a gas-tight swing joint without the usual boring and grinding heretofore required. Also, the combination of the key with the lower end of the plug, when the same is used as a 'gas cock,' so as to dispense with a distinct barrel heretofore required for a cock."

130. For an *Improvement in the Construction of Tubular Condensers and Heaters;* Uel West and Abner Mills, City of New York.

Claim.—"The connexion of the ends of the tubes with the conductors, by squaring the ends of the tubes fitting the squared ends of the tubes of each row, close together, and making tight joints between them, and inserting the whole united row directly between the two parallel sides or portions of the conductor, and securing each tube closely to the said sides or portions."

131. For an *Improved Raking Attachment for Harvesters;* William Whitely, Jr., Springfield, Ohio.

Claim.—"The combination of the balance lever with plate, for operating the rake in its forward motion."

132. For an *Improvement in Adjustable Cut-offs for Steam Engines;* William Wright, Hartford, Connecticut.

Claim.—"The construction and arrangement of the adjustable cut-off, consisting of the cylindrical hubs, disks, and their adjustments. Also, the flap valve checks, constructed and combined with the drop valve."

133. For an *Improved Apparatus for Hoisting Coal;* J. Claude White and Robert Hay, Tuckerville, Pennsylvania.

Claim.—"The bucket, with its inclined base, its doors, and spring latches, in combination with the chute and inclined planes."

134. For an *Improved Finger Bar Arrangement for Harvesters;* James A. Moore and Asahel H. Patch, Louisville, Kentucky.

Claim.—"The combination and arrangement of the folded sheet metal bar with fingers, when the latter are inserted through holes in the front and rounded folded portion of the bar, and griped and pinched between and by the lips of the bar in the rear, and secured therein."

135. For an *Improvement in Hand Corn Planters;* Thomas A. Chandler, Rockford, Illinois, Assignor to self and Harlow Herrick, La Grange, Ohio.

Claim.—"The slides, diggers, and rod. Also, the jaws, cut-off, and arm."

136. For an *Improvement in Sewing Machines;* William C. Watson, Assignor to self, George H Wooster, and Morris Knight, City of New York.

Claim.—"The revolving and reciprocating looping hook. Also, the inclined and grooved brace plate, so placed beneath the cloth as to deflect the lower end of the needle to one side of its path, whereby its vibrations are prevented, and it is secured from breakage by the lateral pulls."

Additional Improvements.

1. For an *Improvement in Rotary Brick Machines;* George Crangle, Philadelphia, Pa.; patented, June 3, 1856; additional patent, September 9, 1856; 2d additional patent, Nov. 25, 1856.

Claim.—"The application of the cut-off slides, so as to slide up and down in contact with the plungers, respectively, and so as to produce in combination with the lower guide piece, the alternately open and close chambers beneath the plungers."

2. For an *Improvement in Harvesting Machines;* George Esterly, Heart Prairie, Wis.; patented, October 22, 1844; additional patent, Nov. 25, 1856.

Claim.—"The method of constructing the arm of the axle, in combination with the metallic box, and the socket, and yoke, whereby the adjusting apparatus is placed beneath the body of the carriage."

RE-ISSUES FOR NOVEMBER, 1856.

1. For an *Improvement in the Machine for Cutting Shoe Pegs;* Stephen K. Baldwin, Gilford, New Hampshire; patented July 16, 1842; extended; re-issued November 4, 1856.

Claim.—"The combination of the vibrating knife, or its equivalent, with the fluted roller."

2. For an *Improvement in Sewing Machines;* Elmer Townsend, Assignee of Alfred Swingle, Boston, Mass.; patented July 22, 1856; re-issued Nov. 4, 1856.

Claim.—"The employment of a hook in connexion with the looping needle, and arranging said hook so that it shall pass into the cloth or material from the same side of it on which the looping needle work is situated. Also, the new or improved method of arranging the feed motion or mechanism, the feed wheel thereof being disposed horizontally, and its teeth made to engage with those of the rack situated on the vertical side of the clamp."

3. For an *Improvement in Nut Machines;* Robert Griffiths, Philadelphia, Penna.; patented October 30, 1855; re-issued Nov. 25, 1856.

Claim.—"A combination of tables, boxes, and punches, or any equivalent thereto."

DESIGNS.

1. For *Stoves;* James J. Dulley, Assignor to Fuller, Warren & Morrison, Troy, N. Y.; November 4, 1856.

Claim.—"The ornamental design and configuration of the plates or castings for Franklin stoves."

2. For *Parlor Stoves;* Elisha Smith, Albany, New York; Nov. 11, 1856.

Claim.—"The combination and arrangement of ornamental figures and forms, for the plates of a parlor stove."

3. For *Kitchen Stoves;* S. W. Gibbs, Albany, Assignor to Thomas H. Wood, Henry S. Hubbard, and John E. Roberts, Utica, N. Y.; Nov. 25, 1856.

Claim.—"The external ornament and configuration of kitchen stoves."

DECEMBER 2.

1. For an *Improvement in Mop-heads;* Frederic Allen, Worcester, Mass.

Claim.—"My improved spring clamp mop-head, as made of a bar of spring steel, bent and formed with an eye and a hook at its opposite ends, and having a link applied thereto, so as to operate therewith."

2. For an *Improvement in Feeding Paper to Printing Presses;* Moses S. Beach, Brooklyn, New York.

Claim.—"Seizing the back or tail-end of the sheet, and thus returning it to the types for a second impression."

3. For an *Improvement in Earthen Vessels for Hermetically Sealing Purposes;* Edwin Bennett, Baltimore, Maryland.

Claim.—"Constructing the covers or lids of such vessels, with the beveled or sloping edge, and plane surfaces unglazed, or in the biscuit state, when said lid or cover is used in combination with a vessel, the contiguous surfaces of which are also left unglazed, and in an absorbent state."

4. For an *Improved Wristband Fastener;* John P. Derby, Boston, Mass.

Claim.—"Arranging and combining with a face plate, two parallel cross pieces, one of which, the lower or second cross-piece, being constructed with a movable section. Also, the hollow stem through which the post passes that is connected with the movable section of the cross-piece. Also, the arrangement of the lever, in connexion with the face plate and the movable section of the cross-piece, whereby by turning the face plate the desired motion is given to the cross-piece or wing; the whole making an effective fastener."

5. For an *Improved Mode of Backing Electrotype Plates;* Wm. Filmer and Edward Bookhout, City of New York.

Claim.—"1st, The box or hopper placed in an inclined position, and the plate placed within the box or hopper, the bottom of the box or hopper being provided with ledges. 2d, The spiral springs, interposed between the shell and plate."

6. For an *Improvement in Nut Machines;* Robert Griffiths, Philadelphia, Penna.

Claim.—"1st, The manner of securing the punching and cutting bars between the sliding plates. 2d, The combining of the punching and cutting bars with the strippers, the said strippers being whole or divided."

7. For an *Improvement in Ovens;* John P. Hayes, Philadelphia, Pennsylvania.

Claim.—"1st, Making an oblong opening through the plate, which is fixed to the back of each of the ovens. 2d, The arrangement of the soot-catching trough at the back of each of the said ovens."

8. For an *Improved Method of Clamping Cutters in Cutter Heads for Planing Machines;* Jonathan P. Grosvenor, Lowell, Massachusetts.

Claim.—"Connecting the collars with each other or with the core blocks, by means of tongues and grooves."

9. For an *Improved Raking Apparatus for Harvesters;* Stephen R. Hunter, Cortlandt, New York.

Claim.—"The bar, attached or hinged to the arms on the platform, and operated by the spring chain ball, which is fitted in the box, and the plate wheel, when the above parts are arranged to operate in combination with rotary cutters and endless apron.".

10. For an *Improved Rock Drilling Machine;* Martin and John P. Gore, St. Louis, Missouri.

Claim.—"The combination of the rock shaft and its arms, with the pawls, ratchets, and the collar on the drill shaft, for effecting the feed and turning of the drill by the upward movement of its shaft."

11. For an *Improvement in Railroad Chairs;* James H. Morley, St. Louis, Mo.

Claim.—"Fishing the joint of railroad bars with a divided chair, to ease the grip of the chair to the rail on the bottom flanch of the rails, when so constructed that the divided bed of the chair shall not come into contact with or impinge upon each other, so as to bear any part of the strain of a weight upon the rails, but leave the upper jaws free to bite with the whole strain of the bolts, whereby they are made to gripe the rail joints more firmly as the cars move over them, without the necessity of being supported upon ties or bearers as heretofore."

12. For an *Improvement in Pentagraphs;* Henry Neumeyer, Macungie, Penna.

Claim.—"The upper sliding frame, in combination with the under stationary frame and casing, and the traversing cog-racks and uprights, the slotted traversing bed plate, with the traversing drawing board or tablet; the compound cog and geared cone pulleys, the compound or double and adjustable rack devices. Also, the grooved sliding rack bar of the traversing rack with its devices, when combined with their pinions and cone pulleys, and the traveling carriage."

13. For an *Improvement in Drying Cylinders for Fibrous Manufactures;* Horace W. Peaslee, Malden Ridge, New York.

Claim.—"The employment of a spiral tubular heater upon a non-conducting cylinder, in combination with an exterior metallic casing."

14. For an *Improvement in the Baby Walker and Jumper;* E. Y. Robbins, Cincinnati, Ohio.

Claim.—"The arrangement of the upward extension of the broad based castor supported frame of the apparatus, around and over the head of the child placed therein, for the purpose of preventing his head from coming in contact with articles of furniture as he moves himself over the floor, and forming a support for the jumper (or child-sustaining canvass-covered hook), and also serving the purpose of suspending toys above the head of the child, and within his reach, to amuse him, and at the same time cause him to judiciously exercise his arms and chest."

15. For an *Improvement in Expanding Tap;* Harley Stone, Uxbridge, and Mason D. Cole, Blackstone, Massachusetts.

Claim.—"The arrangement of the cam piece, the nut and screw, and their connexion with the cutters and case."

16. For an *Improved Ice Saw;* Stephen Scotton, Richmond, Indiana.

Claim.—"1st, The saw, operated or rotated, and placed in the swinging frame, which is rendered adjustable by means of the rack, pinion, and notched wheel. 2d, Moving the platform, and feeding the saw to its work by means of the wheels on the driving shaft, the pinion and screw on the shaft, and the toothed wheel on the axle. 3d, Moving the platform laterally when necessary, by means of the wheel on the shaft, and the wheel on the plate."

17. For an *Improved Axle Box;* William H. Saunders, Hastings, New York.

Claim.—"A lining of a thin tube of condensed and hardened ductile metal or composition, introduced and secured within the box, and presenting a hard polished surface to the axle itself."

18. For an *Improvement in Syphon a Clapit;* Henry M. Walker, Watertown, Conn.

Claim.—The application of a device for the simultaneous opening and closing of the orifices at each end of a syphon."

19. For an *Improvement in Converting Rotary into Reciprocating Motion;* Albin Warth, City of New York.

Claim.—"The intermittent semi-rotating head, or its equivalent, carrying in eccentric relationship to the bearing of said head, a driving pinion for gear with the endless rack, and driven by or operating through suitable gear, a pinion arranged with separate action concentric to said head, the latter being combined with sliding stops, or their equivalents."

20. For an *Improvement in Self-Acting Rakes for Harvesting Machines;* Jesse Whitehead, Manchester, Virginia.

Claim.—"The combination of the rakes and rod, when said parts are made to operate together and independently of each other. Also, in combination with the rakes and rod, the permanent cam and yielding cam, which causes said rakes to advance in one line and return in another line. Also, in combination with the rake head, the rod having its support alternately in and for the purpose of preventing said rake head from binding on its ways. Also, giving the rake a movement varying to the size of each and every gavel."

21. For an *Improved Method of Applying Steam to, and of Cutting Scarfs from Wood;* Job White, Belfast, Maine.

Claim.—"1st, The arrangement of the cams and beam, in combination with the feeding gear, by which the perpendicular and rotary motion of the log is made immediately after the cutters have passed through, giving exact feed to continue a circular kerf around the diminishing surface of the log, making a board of uniform thickness. 2d, The mode and arrangement by which I apply steam or heat to a log in the process of being sawed, by which I am able to apply to the surface of the log immediately before the cutters, and at the particular time and place required for the work designed. The same result may be obtained by a cast iron hollow form, by which you may apply either steam or heat to the surface of the log."

22. For an *Improvement in Wrenches;* Orin O. Witherell, City of New York.

Claim.—"Attaching the fixed jaw of the wrench to a handle, which has its extremity made eccentric by a fulcrum pin, and arranging the movable jaw relatively to said end of the handle and to the fixed jaw."

23. For an *Improvement in Railroad Car Seats and Couches;* Theodore T. Woodruff, Alton, Illinois.

Claim.—"The combination of the movable and fixed frames on one side of each compartment, with the movable and fixed frames on the opposite side thereof, to form each of two depressed couches when unfolded and connected, and which may be converted into two opposite seats when the two movable seats are thrown up and over the perma-

nent frames. Also, combining each of the hinged folding backs on one side of each compartment, with each of the corresponding hinged backs on the opposite side of the same compartment, by means of the folding or connecting frames, or equivalent therefor, whereby the same may be used as backs for the seats or as couches. Also, forming an elevated couch above the windows by the combination of the two sets of hinged frames, so that when not required to be used as a couch, the two sets of frames may be folded up out of the way."

24. For an *Improvement in Railroad Car Seats and Couches;* Theodore T. Woodruff, Alton, Illinois.

Claim.—"In combination with the movable frame and the fixed frame, the employment of the movable seats at the ends of the several divisions, to give the required number of seats when the couches are not used for the purpose of reclining. Also, converting the back of the side seats into an elevated couch, by connecting the upper or back edge of said back to the side of the car, or to the partitions, by hinged joints or other equivalent means, and holding it up in the required elevated position by means of catches, or other equivalent means, in combination with the movable frame and fixed frame, or any equivalent therefor. Also, the manner of connecting the upper or fourth couch with the car, so that it may be let down to be used as a couch, or thrown up to the roof of the car when not required to be used. Also, in combination with the said upper or fourth couch, the hinged or suspended step, for the double purpose of a step to give access to the said upper couch when used as such, and as a means of securing said couch when thrown up out of the way."

25. For an *Improvement in Vault Covers;* Thomas Floyd, Assignor to self and George H. Merkin, Chambersburgh, Pennsylvania.

Claim.—"The guides working in grooves, in combination with cross-bar, spring, and rod, for the purpose of elevating the cover. Also, guides, in combination with catches or bolts and springs, for fastening the cover down."

26. For an *Improvement in Engines for Grinding Paper Stock;* Vespasian O. Balcom, Bedford, Mass., and Charles H. Hill, Billerica, Mass.

Claim.—"The revolving pulp tub, or its mechanical equivalent, in combination with the grooved grinding roller, revolved therein at a greater or different speed than this tub. Also, the combination of the revolving pulp tub, and friction or evening roller."

27. For an *Improvement in the Bramah Planing Wheel;* Edwin Jones, Greenfield, Massachusetts.

Claim.—"Providing the planing wheel with knives for edging or jointing the articles when arranged as a single instrument."

28. For an *Improvement in Covering Thread with Wool;* Andrew L. Fuller, Clinton, Massachusetts.

Claim.—"The mode of placing the core in the sliver, and covering it by the combined action of the comb and condenser, so as to produce the sliver, and this I claim whether a twist be given to the sliver or not."

29 For an *Improvement in Steering Apparatus for Ships;* David W. Smith, Boston, Massachusetts.

Claim.—"The arrangement of the guard rack and the pinion on the tiller, with the main rack and the pinion of the hand wheel shaft."

30. For an *Improvement in Casting Metallic Tubes;* James Smith, Jr., Norton, Massachusetts.

Claim.—"The method of making the metallic mould core, viz: of removable separate sections or staves, and a narrow trapezoidal or wedge-shaped spring or stave, the whole being arranged and held together by rings and plugs, or their mechanical equivalents."

31. For an *Improved Hand Stamp;* Nathan Ames, Saugus, Mass., Assignor to Boston Hand Stamp Company.

Claim.—"In combination with the other parts of any stamp to be held in the hand the leg or wire so constructed as to strike the article to be printed in advance of the

type block, and thereby cause the inking roller to pass over the printing surface, while the latter is descending. I do not confine myself to any particular manner, as there may be many in which the leg may be made to communicate motion to the inking roller, but I claim this leg both independently of the inking apparatus and the other parts of the stamp."

MECHANICS, PHYSICS, AND CHEMISTRY.

*On Water Metres.**

Sir,—Your August number contains an article describing Mr. Kennedy's Water Metre, and embodying a report, by Mr. G. W. Stevenson, of Halifax, on the comparative results obtained by him in testing Taylor's, Siemens', and Kennedy's metres.

Being interested in one of the metres referred to, which bears my name, I shall refrain from criticism of Kennedy's metre; but I feel called upon to trouble you with a few remarks regarding Mr. Stevenson's experiments, with a view to caution your readers and the public against hasty conclusions, and to elicit truth by inviting to farther and more careful inquiry.

In order to avoid misapprehension, I beg to state distinctly that I do not doubt Mr. Stevenson's scrupularity in stating the results of his experiments such as he found them; but what I object to is, his mode of conducting the experiments, which affords no security against error, which leads to erroneous conclusions respecting the capabilities of each metre, and also leaves untouched the two chief desiderata of a water metre,—those, namely, of durability and facility of application.

1. *As to the accuracy of measurement.*

Mr. Stevenson filled a gallon measure one hundred times through each metre, and found that in the first experiment Siemens' metre went 5 per cent. too fast; in the second, one per cent. too slow, and in the third correctly; whereas Kennedy's metre was always correct within 1 per cent. It would appear from this, that Siemens' metre varied as much as 6 per cent. between two consecutive experiments, which I believe, from *long experience*, to be *quite impossible*. But it is not difficult to account for an error of a few per cent. by Mr. Stevenson's primitive mode of measuring the water as it is passed through the metre, and in reading so small a quantity as 100 gallons upon a dial indicating 1000 gallons by one single turn. I maintain that the proper way of trying the accuracy of a metre is, to pass through it a quantity not less than 1000 gallons, and to run the same into a cistern holding that quantity between marks ascertained by exact calculation, or rather by weight.

2. *As to relative quantity delivered.*

Mr. Stevenson has taken for his standard of comparison the diameter of the unions attached to each metre, whereas the proper standard would have been similar quantities stated to be delivered according to the published prospectuses.

Experience has induced Messrs. Guest and Chrimes, the manufactu-

* From the Lond. Civ. Eng. and Arch. Journ., Sept. 1856.

rers of Siemens' metres, to limit the power of delivery to what is practically required, by restricting the passage through the metre. Such restriction will not impede the flow of water through a long range of pipes (it is well known to engineers practically acquainted with water works, that a sluice in a range of pipes may be more than half shut without impeding the flow of water, the reason being that the vis inertia the water acquires in passing the restriction is spent again in the succeeding pipe in urging the water column forward), but is intended to diminish the delivery in cases where the metre is placed at the extremity of a pipe. High pressure metres are generally applied below ground at the entrance of a branch pipe into an establishment; and in order to test the real capabilities of such a metre, it ought to be placed as nearly as possible under these normal conditions, which was not the case in Mr. Stevenson's experiments. But adopting for the sake of argument, Mr. Stevenson's results, he is evidently mistaken when he says that "the price also (of Kennedy's metre) is really less *pro rata* than that asked for either Taylor's or Siemens'. Taylor's being £5 per inch, Siemens' a little more, and Kennedy's about eight guineas." The report goes on: "The capacity for supply, however, ought to regulate the price, &c." Now, if Mr. Stevenson would refer to Messrs. Guest and Chrimes' list of prices, he would find that their metre with 1½ inch inlet, will deliver just twice the quantity of their 1 inch, and consequently the same quantity as Mr. Kennedy's with 1 inch inlet. The price of Siemens' metre with 1½ inch inlet is, however, only £3 6s., or slightly less than Kennedy's of the same power of delivery, under the unfavorable circumstances of the experiment. No account is taken of the cost of transport and erection, which in the case of Kennedy's metre exceeds considerably that of Siemens' metre, owing to its far greater bulk and weight.

3. *As to relative loss of pressure sustained by the passage of water through the metre.*

In Kennedy's metre the water has to move a piston and to pass through several short bends, whereas in Siemens' it has always a free passage through curvilinear channels, that represent, together with the inlet, two bends. It is, therefore, not well possible that Siemens' metre should impede the water more than Kennedy's, provided the quantity of water delivered does not exceed the limits assigned to it.

Having now referred to the three points of Mr. Stevenson's investigation, I have to suggest a fourth point, which far exceeds the others in importance, namely:

4. *As to durability.*

It is a comparatively easy problem to produce a metre that shall give satisfactory results in a laboratory experiment. Indeed the first metre the writer ever made, in 1851, left little to be desired in this respect, and was highly approved by a committee of the Manchester Corporation Waterworks. All the difficulty, however, was to come, and consisted in producing an instrument from which more is required than ordinary mechanism will stand. A high pressure water metre is generally placed below ground, and is required to work for several years without needing any attention whatever. Unlike the gas metre, it has to work under pressure ranging from a few inches to 300 feet of water column; it has to resist great con-

cussions in the water, and to be unaffected by impurities—such as sand, shells, and vegetable matter—in the water, nor by its calcareous deposits; combining with this extreme delicacy of action. It remains for Mr. Kennedy to prove that his piston, tumbler, and valve possess the quality of resisting permanently these agencies; but in order to judge of the relative merits of several metres, I should suggest to put the same in a trying situation, both as regards pressure and impurities (at the end of a low-level main for instance), to lock them up for six or twelve months, and then examine them as regards their accuracy of measurement and general state of conservation.

In conclusion, I may be allowed to state an interesting fact regarding Siemens' metres, namely, their accuracy (within 3 per cent.) and their durability being guarantied by the manufacturers; all defective metres are returned to them, and the number so returned, during the last 14 months, has been 33 out of nearly 2000 metres in operation. The increasing demand for them does not bear out Mr. Kennedy's statement, that no satisfactory metre existed before his own was proposed.

London, 25th August, 1856. W. Siemens.

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*On Nature Printing.** Henry Bradbury, Esq., M. R. I.

The art of nature printing is a method of producing impressions of plants and other natural objects, in a manner so truthful that only a close inspection reveals the fact of their being copies. So distinctly sensible to the touch are the impressions, that it is difficult to persuade those unacquainted with the manipulation, that they are the production of the printing press. The process, in its application to the reproduction of botanical subjects, represents the size, form, and color of the plant, and all its most minute details, even to the smallest fibre of the roots.

The distinguishing feature of the process, compared with other modes of producing engraved surfaces for printing purposes, consists, firstly, in impressing natural objects—such as plants, mosses, seaweeds, feathers, and embroideries—into plates of metal, causing as it were the objects to engrave themselves by pressure; and secondly, in being able to take such casts or copies of the impressed plates as can be printed from at the ordinary copper-plate press.

This secures, on the one hand, a perfect representation of the characteristic outline of the plant, as well as that of some of the other external marks by which a plant is known, and even in some measure its structure, as for instance in the venation of ferns, and the leaves of flowering plants; and on the other, affords the means of multiplying copies in a quick and easy manner, at a trifling expense compared to the result obtained—and to an unlimited extent.

The great defect of all pictorial representations of botanical figures has consisted in the inability of art to represent faithfully those minute peculiarities by which natural objects are often best distinguished. Nature printing has therefore come to the aid of this branch of science in particular, whilst its future development promises facilities for copying other

* From the Royal Institution of Great Britain.

objects of nature, the reproduction of which is not within the province of human hand to execute; and even were it possible, it would involve an amount of labor scarcely adequate to the results obtained.

Although considered for some years past in various parts of Europe as a new art, the idea is by no means so recent as is supposed: much less is there ground for the Austrians to assert their exclusive right to the priority of the invention, merely on account of the first application of the process in its fullest extent in the Imperial Printing-Office at Vienna.

Councillor Auer* has not only done this, but he has claimed for nature printing a position to which it has no right: he has compared it to the invention of writing and the art of printing; moreover, he has placed it on an equality with the Galvanoplastics of Jacobi and Spencer, and the Daguerreotypes of Daguerre. Valuable as are the results of nature printing, it still has its defects; it has its limits, and its applications are limited, and care will be required to confine it within the bounds of its capabilities.

That an establishment, so renowned for its productions as that at Vienna, unlimited in its command of the resources of science and mechanism, should have been the first to bring any invention connected with printing to a practical state of perfection, is not matter to create surprise; but that it should, in the most unqualified manner, in the name and on authority of its chief director, claim all the honor of the discovery, is a point that is open to question, and in point of fact is questioned by several private individuals, who, for want of those unlimited resources and opportunities which only government establishments are able to command, were unable to crown their experiments with practical results.

Nature printing is nothing more than an application of facts worked out by various persons, in different countries, under very different circumstances, and at very different periods; and by tracing out its history, and detailing the earlier experiments connected with it, Mr. Bradbury hoped to show that he did not put forward personally any claim either to its origin or to its first application; but, that he spoke as one who, having perceived its value, was desirous to render it an available auxiliary to the printing press.

Nature herself, in her mysterious operations, seems to have given the first hint upon the subject: witness the impressions of Ferns so beautifully and accurately to be seen in the coal-formations.

Experiments to print direct from nature were made as far back as about two hundred and fifty years—it is certain that the present success of the art is mainly attributable to the general advance of science, and the perfection to which it has been brought in particular instances.

On account of the great expense attending the production of woodcuts of plants in early times, many naturalists suggested the possibility of making direct use of nature herself as a copyist. In the *Book of Art*, of Alexis Pedemontanus, (printed in the year 1572,) and translated into German by Wecker, may be found the *first* recorded hint as to taking impressions of plants.

At a later period in the *Journal des Voyages*, by M. de Moncoys, in 1650, it is mentioned that one Welkenstein, a Dane, gave instruction in making impressions of plants.

* *Vide* Denkschriften der Kais. Akademie, Wien; Math.-Nat. Classe Band V., p. 107, (illustrated by many plates.)

The process adopted to produce impressions of plants at this period, consisted in laying out flat and drying* the plants. By holding them over the smoke of a candle, or an oil lamp, they became blackened in an equal manner all over; and by being placed between two soft leaves of paper, and by being rubbed down with a smoothing-bone, the soot was imparted to the paper, and the impression of the veins and fibres was so transferred.

Linnæus, in his *Philosophia Botanica*, relates that in America, in 1707, one Hessel made impressions of plants; and between 1728 and 1757, Professor Kniphof, at Erfurt, who refers to the experiments of Hessel, in conjunction with the bookseller Fünke, established a printing-office for the purpose. He produced a work entitled *Herbarium Vivum* (a copy of which was laid before the Members). The range and extent of his work, twelve folio volumes, and containing 1200 plates, corroborates the curious fact of a printing-office being required. These impressions were obtained in a manner very similar, but with the substitution of printer's ink for lamp-black, and flat pressure for the smoothing-bone. A new feature at this time was introduced—that of coloring the impressions by hand, according to Nature—a proceeding which though certainly contributing to the beauty and fidelity of the effect, yet had the disadvantage of frequently rendering indistinct, and even sometimes totally obliterating, the tender structure and finer veins and fibres. Many persons at the time objected to the indistinctness of such representations and the absence of the parts of fructification; but it was the decided opinion of Linnæus, that to obtain a fac-simile of the difference of species was sufficient.

Seligmann, an engraver at Nuremburg, in 1748, published in folio plates figures of several leaves he had reduced to skeletons. As he thought it impossible to make drawings sufficiently correct, he took impressions from the leaves in red ink, but no mention is made of the means he adopted. Of the greater part he gave two figures, one of the upper and another of the lower side.

Even at this early period the idea must have excited much attention; for it is recorded that Seligmann had announced his intention to give figures of natural objects as magnified by a solar microscope, and that two were to have been published every month. But he died soon after, and a law suit prevented the prosecution of his work. Two black and twenty-nine red plates of leaves had been already completed, and were published with eight pages of text, in which his coadjutor, Crew, speaks of the physiology of plants, and Seligmann of the preparation of leaf skeletons. The leaves represented on the plates were those of the orange, lemon, shaddock, &c.

In the year 1763 the process is again referred to in the *Gazette Salutaire*, in a short article upon a *Recette pour copier toutes sortes de plantes sur papier*.

About from twenty-five to thirty years later, Hoppe edited his *Ectypa Plantarum Ratisbonensium*, and also his *Ectypa Plantarum Selectarum*, the illustrations in which were produced in a manner similar to that em-

* Although the plants were dried in every case, Mr. Bradbury stated, that it was by no means absolutely necessary, as he proved by the simple experiment of applying lamp-black or printer's ink to a fresh leaf, and producing a successful impression.

ployed by Kniphof. These impressions were found also to be durable, but still were defective. The production of impressions could only take place very slowly, as the blacking of the plants with the printer's ball required much time. Rude as the process was, and imperfect the result, it was nevertheless found that the figures thus produced were far more characteristic than any which artists could produce. The fault of the method consisted in its limited application and in its incompleteness; since the fragile nature of the prepared plant, if ever so carefully treated, would admit of but very few copies being taken, and where any great number would have been required, many plants must have been prepared, a circumstance which was in itself a great obstacle.

In the year 1809 mention is made in Pritzell's "Thesarus" of a *New Method of taking Natural Impressions of Plants;* and lastly, in reference to the earlier history of the subject, the attention of scientific men was called to an article, in a work published by Grazer, in 1814, on a *New Impression of Plants.*

Twenty years afterwards, the subject had undergone remarkable change, not only in the mode of operation to be pursued, but also in the result produced,—which consisted in fixing an impression of the prepared plant in a plate of metal by pressure.

It appears, on the authority of Professor Thiele, that Peter Kyhl, a Danish goldsmith and engraver, established at Copenhagen, applied himself for a length of time to the ornamentation of articles in silver ware, and the means he adopted were, taking copies of flat objects of nature and art in plates of metal by means of two steel rollers.

Various productions in silver of this process were exposed in the Exhibition of Industry held at Charlottenburgh, in May 1833. In a manuscript, written by this Danish goldsmith, entitled *The Description (with forty-six plates) of the Method to Copy Flat Objects of Nature and Art*, dated 1st May, 1833, is suggested the idea of applying this invention to the advancement of science in general. The plates accompanying this description represented printed copies of leaves, of linen and woven stuffs, of laces, of feathers of birds, scales of fishes, and even of serpent-skins.

The manuscript contains ample and clear instructions to carry out the method, and a few extracts, in his own words, of the leading features will be perhaps interesting. He thus writes:—

"As a correct copy of the productions of Nature and Art must be of great importance, I am delighted to have the honor of submitting to the friends of Art and Science a method I have discovered, by which copies of most objects can be taken, impressed into metal plates, and which enables the naturalist and botanist to get representations of leaves, feathers, scales, &c., in a quick and easy way; and these copies will give all the natural lineaments, with their most raised or sunken veins and fibres; moreover, the artist can, by means of this invention, make use of Nature's real peculiarities for ornamental compositions and productions; and the merchant can get patterns of delicately woven or figured stuffs, laces, tickens, ribbon, linen, and so forth.

"To fix an impression into a plate of copper, zinc, tin, or lead, properly prepared for the purpose, a rolling machine with two polished

cylinders of steel is required; if a *leaf*, quite dried and prepared, is placed between a polished steel plate half an inch thick and a thoroughly heated lead plate with a fine surface, and these two plates with the leaf between be run speedily between the cylinders, the leaf will by the pressure yield its form on the softer lead plate, precisely as it is shaped, with all its natural raised and sunken parts.

"I tried many ways to fix the leaf on the plate by some glutinous matter, but it filled the delicate pores and deep parts so much as to render the copies very indistinct.*

"The printing itself of the leaf into the metal requires much precaution, especially with respect to placing the cylinders exactly parallel, and at the same time at a proper distance, and to have the plate to be stamped carefully burnished and polished; besides, the utmost care must be used, as particles of dust or dirt would be printed together with the object itself. Moreover, care must be taken, that the rolling of the plates is managed well, so as to run parallel, without deviating from their first direction.

"Leaves that are to be printed must first be spread upon a clean sheet of paper and placed upon a warm oven; a second sheet put over them is to be strewn with sand, and the whole left to dry under a weight. This done the leaves are taken out with due precaution, and placed for a quarter of an hour into water. They are dried again in the same way, and this manipulation is repeated four or five times. By this means I always found that the leaves gained in tenacity and firmness, that they lost all their moisture, and became more fit to be stamped. Objects, such as laces, weavings, figured ribbons, and such like, can be printed without any preparation, provided they be spread flat between the plates.

"The season being very unfavorable for gathering good strong leaves, I had to overcome many difficulties, so that the copies are not so good as they might have been—for I have observed that leaves obtained from green-houses do not yield such distinct prints as those that grow in the open air, when properly developed."†

It would appear from the practical hints here given, that Peter Kyhl was no novice at the process. He distinctly points out what he conceives to be its value, by the subjects that he tried to copy; and he enters into detail on the precautions to be observed in the operation of impressing metal plates so as to insure successful impressions. His manuscript explains that he had experimented with copper, zinc, tin, and lead plates. Still there existed obstacles which prevented him from making a practical application of his invention. In the case of zinc, tin, and copper, the plant, from the extreme hardness of the metals, was too much distorted and crushed; while in lead, though the impression was as perfect as could be, there was no means of printing many copies, as it was not pos-

* Mr. Bradbury stated that he had himself tried this method without success.

† This allusion to the want of tenacity and firmness in young, and especially in green-house plants, is quite consistent with the experiment made at the present time. Mr. Bradbury stated, that to obtain an impression at all, upon a plate of metal, of a plant, it was indispensable that the plant should be thoroughly dried and free from sap; otherwise the plant would spread in all directions, without leaving any visible indentation. Objects such as lace, and figured fabrics, can be impressed without any preparation, provided they be spread flat between the plates.

sible after the application of printer's ink to retain the polished surface that had been imparted to the lead plate, or to cleanse it so thoroughly as to allow the printer to make impressions free from dirty stains. This was a serious obstacle, which was not compensated for even by the peculiar rich surface of the parts that were impressed, attributable to the lead being more granular than copper, and which is so favorable to adding density or body of color, without obliterating the tender veins and fibres. Peter Kyhl died in the same year that he made known his invention. At his death, his manuscripts and drawings were deposited in the archives of the Imperial Academy at Copenhagen, where they remained for upwards of twenty years: and it is a remarkable fact, that, shortly after his death, was discovered the only thing wanting to render the process, as explained by him, at once available for practical purposes. Had Kyhl lived to prosecute his experiments, he might have accomplished more than he did without requiring the aid of other means.* It was he who discovered how to take impressions in metal plates, by using steel rollers.

This is the first element in the process of Nature Printing. It fell to Dr. Ferguson Branson, of Sheffield, to suggest the second, and the most important.

(To be Continued.)

For the Journal of the Franklin Institute.

Particulars of the R. M. Steamer Arabia, (Cunard Line.)

The following particulars of this steamer, are given in addition to those that have been before published (*vide Journal*, vol. xxv., pp. 122, 137).

HULL.—

Length of keel and fore rake,		255 feet.
Breadth over wheel-house,		40 " 8 inches.
" of beam,		66 " 4 "
Depth of hold,		27 " 6 "
" over flanching,		30 " 10 "
Length of engine room,		62 " 6 "
Draft of water (mean),		19 "
Area of midship section at this draft,	606 sq. ft.	
Displacement at "	3900 "	
Horse-power (Admiralty),	873 "	

Cylinders—103 in. in diameter × 9 feet stroke.
Air-pump—60½ in. diameter × 4 feet 7 in. stroke.

Height of water wheel shaft,		22 feet 9 inches.
Diameter of water wheel,		37 " 6 "

Wheel blades—28 of 10½ feet in length × 3 feet 2 inches.

BOILERS.—Four tubular, with 24 furnaces.

Furnaces—8 feet 4 in. × 3 feet 2½ inches.		
Area of grate surface,	642 sq. ft.	
Heating surface,	16,948 "	
Length of fire rooms,		12 feet.

C. H. H.

* Khyl, as it was, had had his attention directed and had made experiments to overcome this one remaining difficulty. His manuscript also contains many interesing and practical remarks upon other processes than simply Nature Printing.

For the Journal of the Franklin Institute.

Particulars of the Steamer William H. Webb.

Hull built by Wm. H. Webb. Machinery by the Allaire Works, New York. Intended service, New York Harbor and Coast.

HULL.—

Length on deck, from fore part of stem to after part of stern post, above the spar deck,	190 feet.	
Breadth of beam at midship section (molded),	31 "	
Depth of hold,	12 "	
" " to spar deck,	12 "	
Floor timbers at throats, molded, 13 ins., sided, 12, 14 and 15 inches.		
Frames apart at centres—30 and 32 inches.		
" strapped with diagonal and double laid iron straps,	4½ by ⅝-inch.	
Draft of water at load line,	7 "	6 inches.
" " below pressure and revolutions,	7 "	6 "
Area of immersed midship section at this draft,	194 sq. ft.	
Tonnage, custom house,	670.	
Contents of bunkers in tons of coal,	25.	
Masts and rig—none.		

ENGINES.—Overhead beam—Vertical.

Diameter of cylinders,		44 inches.
Length of stroke,	10 feet.	
Maximum pressure of steam in pounds,	35.	
Cut-off—½-stroke.		
Maximum revolutions per minute,	22.	

BOILERS—Two—Return flued.

Length of boilers,	30 feet.	
Breadth " front,	10 "	6 inches.
Diameter of round shell,	9 "	
Number of furnaces in each boiler,	2.	
Breadth " "	4 "	7 "
Length of grate bars,	8 "	
Diameter of smoke pipe,	3 "	10 "
Height " "	35 "	
Description of coal,	Anthracite	
Draft,	Natural.	

PADDLE WHEELS.—

Diameter,	30 feet.	
Length of blades,	4 "	7 inches.
Depth "		28 "
Number "	42 halves.	
Dip of wheels,	3 "	9 "

Remarks.—This vessel is built to supply the place of the *Leviathan*, burned off Sandy Hook last Spring. She is admirably designed for the purpose, being modeled for high speed, with independent engines of great power, with great shear of deck forward, and with no other encumbrance upon her deck than wheel and engine houses. She is the exact type of a tug, either as a tow-boat or to relieve stranded vessels, for which duty her great power, and independently acting engines, render her unequalled in any waters.

As a means of comparison by which to estimate her power, the following elements are conclusive. The *Leviathan*, the fastest steamer ever

built in any country, had 196 cubic feet of steam cylinder to an immersed section of 176 square feet. This steamer, with a like model, has 211 cubic feet of cylinders, to 194 square feet of like section.

C. H. H.

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*Captain Uchatius's New Process for the Manufacture of Steel.**

For the satisfaction of a number of scientific gentlemen, engineers, and others interested in the subject, an exhibition of the new method of manufacturing steel, the discovery of Capt. Uchatius (Engineer in Chief of the Imperial Arsenal at Vienna), was made on Saturday, October 11th, at Messrs. Rennie & Sons, the Albion Engine Works, Holland street, Blackfriars-road.

Mr. Charles Lentz, the partner of Captain Uchatius, operated on the occasion, assisted by workmen from the factory of Messrs. Turton & Co., at Sheffield. Whilst the process was going on, Mr. Lentz read a paper descriptive of the invention. He commenced by explaining that he had labored under many disadvantages in being compelled to contrive substitutes for the regular furnaces and other proper appliances peculiar to steel works, but, nevertheless, an opinion could be there formed of the merits of this important invention, for all the melting operations in cast steel manufacture were necessarily a series of operations on a small scale, the size of a steel crucible limiting the magnitude of the furnaces. He proceeded to state that the method adopted in England, and all over the world, he might say, for making the best descriptions of cast steel heretofore, was to convert Swedish or Russian bar iron, by a lengthy, uncertain, and costly process, first into what is called blister steel, which product was then melted down in crucibles and cast into ingots for the manufacture of the bar steel of commerce. The invention about to be exhibited by him would render this country quite independent of Sweden and Russia for steel iron-making, as he would show the company present that East India pig iron, now very plentiful and cheap here, could be converted into fine steel in as few hours as Swedish and Russian bar iron would take weeks to manipulate; in addition to which, he could assure those present that numerous descriptions of ordinary English pig iron would answer for this process equally well, if he might judge from the limited experiments in English iron, he had performed. Indeed, the results of these experiments were very remarkable, and he expected that nearly all the iron works would soon make steel as regularly as they now made iron. He begged the company to consider the importance of a discovery which would so reduce the cost of steel as to render it available for numerous purposes in engineering, now quite precluded by the price; he did not hesitate to assert that fully two-thirds might be saved in the cost of producing cast steel by using the present instead of the old process. Mr. Lentz then proceeded to explain that the invention of Capt. Uchatius was founded upon the well-known fact that cast iron surrounded by any oxygenized materials, and subjected to a cementing heat for a given time, would yield up a portion of its carbon, which

* From the Lond. Artizan, Nov., 1856.

would combine with the oxygen driven off from the surrounding materials, forming carbonic oxide or carbonic acid gas. If this process were interrupted before completion, a partially decarbonized iron would result, the surface of which would have been converted into a pure iron, while the inner parts remained unchanged; or, in other words, the progress of the decarbonizing action would depend on the amount of metallic surface brought into contact with the oxygen-yielding material with which the iron was surrounded. In order, therefore, to expedite this operation, the pig iron was first reduced to a granulated state, which was accomplished by simply running the molten iron from the cupola (a blast furnace in some cases,) into cold water, agitated by mechanical means. This granulated iron was mixed with a proper proportion of pulverized oxygen-yielding materials of a very cheap description, such as sparry iron ore (spathose ore), and adding, if requisite, a small quantity of manganese, which mixture was put into common crucibles, and subjected to heat in a cast steel blast furnace of ordinary construction. By thus subjecting the granules of iron, in presence of the sparry iron ore, to a melting heat, the surrounding oxides would first effect a partial decarbonization of the granulated iron, which decarbonization would be limited in amount according to the size of the granules operated upon, and by reason of the continued application of heat the iron would melt and separate (with the assistance of the melting residue of sparry iron ore) from the impurities with which it was mixed, and also bring down with it a portion of the iron contained in the sparry iron ore, thereby increasing the yield of cast steel by about 6 per cent. The manipulations of melting and casting were the same as those commonly employed by cast steel manufacturers. The quality of the steel made by this process could be considerably modified. Thus, the finer the pig iron was granulated, the softer would be the steel made therefrom. The softer sorts of welding cast steel might be obtained by an addition of good wrought iron in small pieces, and the harder qualities by adding charcoal in various proportions to the before-mentioned mixture. Thus, continued Mr. Lentz, might crude iron be converted into steel ingots in the incredibly short space of about two hours.

Mr. Lentz then proceeded to exhibit the preliminary process of granulating, by running a crucible of melted pig iron into a vessel of water, when it was instantaneously converted into shot-like particles. A weight of 24 lbs. of the granulated iron was mixed with 6 lbs. of crushed ore and peroxide of manganese, in the proportion, it was said, of about 4 lbs. of ore and 2 lbs. of peroxide of manganese, to which was added a small quantity of fire-clay, and filled into the crucible in the temporary furnace, and allowed to melt in the usual manner. In the meantime the company proceeded to witness the operation of the hammering down into a bar of an ingot of this new steel, which had been made a few days since, and although the steam-hammer used was not at all adapted for steel, nevertheless, the bar of steel produced from the ingot then hammered was pronounced to be of excellent quality, and tools made by Messrs. Rennie, from a fellow ingot, were tried and found to possess the qualities of fine English cast steel. After two hours and three-quarters had elapsed since the filling—some defect in the blast a little retard-

ing the melting—the contents of the crucible were poured into the iron mould, from which, when opened, an ingot of steel, weighing 25 lbs., being 1 lb. more than the iron used, was exhibited to the company, which bore every external evidence of being perfect in quality. It was to be forwarded to the steel works of Messrs. Spencer & Sons, of Newcastle-on-Tyne, to be properly tilted into bar steel for further tests as to its quality and properties. The simplicity and rapidity of the new process, as well as the quality of the specimens of steel shown, elicited much admiration. The importance of the process in reducing the cost of steel can scarcely be overrated when the innumerable new uses to which it would inevitably be turned in preference to iron are considered—the expense of steel tyres, axles, piston-rods, shafts, and other important working parts of machinery being estimated as not exceeding the price now paid for first-class iron.

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*The Conical Bullet-Making Machinery.**

Designed by John Anderson, Esq., Inspector of Machinery to the War Department.

When the Minie rifle was introduced in 1852, the hollow elongated bullet was cast in a metal mould in the usual manner; but from the fact of great accuracy being required, both in the density and dimensions of such projectiles, in order to secure the full advantages of this admirable weapon, it soon became apparent that a more refined mode of making these bullets was essentially requisite; at the same time it must be such a mode as would secure the necessary softness in the metal, so as to enable it to expand within the rifle, the whole success of the arm being dependent on that condition.

In the earlier attempts in this direction, the bullets were first cast in a mould, and then stamped accurately with dies in an ordinary fly-press: this method is still resorted to by those who have not better machinery.

An attempt was made by the late Mr. Lovel to cast lead into rods of the required diameter, then by means of hand shears to cut these rods into pellets of the required weight, and, with the aid of a fly-press and pair of dies, to convert these pellets into bullets; but here two difficulties presented themselves.

First. The weight of the bullet depended on the quantity of lead cut off the rod into the pellet; therefore perfect accuracy in that particular could not be secured.

Second. As the whole of the lead cut off to form the pellet had to go towards the construction of the bullet.

The dies had to be made so as to form the required bullet between them, with a certain fixed quantity of lead, any excess being spread over between the dies, and which would have to be pared off by hand; while, on the other hand, any deficiency would allow the dies to come into hard contact, thus destroying their fine edges, and rendering them useless.

In this condition, and with these objections, the shears and fly-press

* From the Lond. Artizan, Nov., 1856.

were put into the hands of Mr. Anderson, in order to have these difficulties overcome, and the result of his perseverance is in the machine before us.

In order to enable the machine to be made self-acting, the lead is squirted into a long rod of about 5 cwt., by means of hydraulic pressure, and which is then wound upon a reel placed above the machine, and from which it unwinds as the manufacture proceeds.

On looking at the plan, it will be seen that there are four separate sets of dies, each of which are complete with lead-reel, cutting-off shears, and die apparatus; and otherwise are exactly alike. It will also be seen that the machine is so constructed that one set of driving apparatus, eccentric motion, and cam shaft, are made to serve for two sets of dies, a bullet being formed at each movement.

The process consists of three operations:—First, cutting off the lead from the rod and delivering it to the dies; second, the forming of the bullet; and third, the mode of stripping off the ring of superfluous lead from the bullet, as it is ejected from the die.

First. The lead rod is unwound from the reel by means of a pair of rollers, which are worked by a ratchet wheel from the reciprocating motion of the machine. These rollers, after a little working, become so loaded on their exterior surface as to prevent any slip, the amount of motion given to the rollers being dependent on the adjustment of the pawl stud in the rocking lever.

The end of the lead rod is pushed through a hole in the lever, this hole being bushed with steel, so as to act as a shear; when the proper quantity is pushed through the hole, the extremity is seized by the pair of nippers, and immediately the end of the lever is raised by a cam, thus separating the piece in the nippers from the rod. So soon as the nippers have the pellet of lead in its own iron fingers, it opens just sufficient to allow it to drop, the lower end of the nippers being so constructed as to hold the lead when it is exactly in front of the dies; at that instant the punch, or movable die, comes towards the fixed die, and pushes it in a very minute distance sufficient to prevent it from falling; then the nippers open at the bottom and close at the top for the next bullet; the several motions of the cutting lever and nippers being worked by cams of the required shape on the horizontal shaft.

To prevent any irregularity in the length of lead pushed through the nippers, a cross-bar, or stop, is placed behind them, the rollers are set to give rather more than the required quantity, thus butting hard each time; the metal being soft yields, and thus prevents accident to the apparatus.

Second. The dies are by far the most important part, and require to be made with extreme accuracy.

The fixed die is made the shape and size of the bullet, but having a movable bottom by means of which the bullet is ejected. The die holder is made adjustable with set screws.

The punch, or movable die, is fixed in the end of the reciprocating spindle; this forms the hollow interior and rear end of the bullet; the two dies, if brought into contact, thus forming a complete bullet.

In order to allow the lead to fill up into the extremities of the bullet,

it is necessary to have not only the fixed die ventilated, but also the punch. The former has a hole through the ejecting spindle about the size of a hair; this allows the air to pass out, but intercepts the lead.

If the two dies that form the bullet were allowed to meet, in order to complete the operation, there would be the constant liability of their coming together without the pressure of lead, which would cause them to destroy each other; for, however rigid the machine might be made, there would be a certain amount of elasticity, which would insure fracture of the dies, to prevent which is the third part of the apparatus.

The two dies are not allowed to meet by about the $\frac{1}{50}$ of an inch, the superfluous lead being formed into a ring or frill around the bullets at the point of junction. When the movable die or punch has performed its part of the operation it retires, and immediately a third die, in the form of a plate of steel, with a hole in it the exact size of the bullet, rises up in front of the fixed die, and through this hole the bullet is ejected, but the ring or frill is stripped off over the bullet towards the point, thus delivering it complete and ready for the cartridge; and by taking care this hole is of the proper size, it forms a gauge to rectify any wear which may take place in the fixed die.

The motions for ejecting the bullet and for working the steel plate are obtained from cams on the cam shaft.

Each set of dies can turn out about 32 bullets per minute; the produce of a machine being about 74,000 per day. There are four of these machines at work in the Royal Arsenal, yielding, when in full operation, about a quarter of a million daily; or, if working night as well as day, as was the case during the war, then the double of that quantity.

To have made this latter quantity by the former system, would have cost, in wages alone, the sum of £62 10s.; but, by the introduction of this machine, it is less than the fiftieth part of that amount; while, as regards accuracy, there can be no comparison.

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*Safety Lucifer Matches.**

The safety lucifer match is the invention of Lundstrom, a Swede, who has a large match manufactory at Jonkoping, in Sweden, where some hundred workmen are employed, and eight or more millions of matches are produced daily. They are about to be introduced into this country by the firm of Bryant & May, London, who are the largest importers of German and Swedish lucifers in the kingdom. A patent has been taken out in their name for the sale in England of the Swedish match. Its peculiarity consists in the division of the combustible ingredients of the lucifer between the match and the friction paper. In the ordinary lucifer, the phosphorus, sulphur, and chlorate of potash or nitre, are all together on the match, which ignites when rubbed against any rough surface. In the Swedish matches these materials are so divided that the phosphorus (which is employed solely in the amorphous state,) is placed on the sand-paper, whilst the sulphur, and a minimum amount of chlorate or nitrate of potash, is placed on the match. In virtue of this arrangement, it is only when the phosphorized sand-paper and the sul-

* From the Lond. Journal of the Society of Arts, No. 194.

phurized match come in contact with each other that the ignition occurs. Neither match nor sand-paper, singly, takes fire by moderate friction against a rough surface. The matches are thus much less liable to cause accident by casual ignition than the ordinary ones ; and the recent edict by the Spanish Government against the employment of lucifers by the peasantry of the forest districts in dry weather (which will certainly be evaded) would be needless, if the Swedish matches were in general use. If they fully answer the announcements of the inventor, and it is due to him to acknowledge that they excited great interest at the Exhibition in Paris last summer, they will soon displace the common lucifer, in virtue alike of their manufacture being much less injurious to the health of the workmen who make them, and to the property of those who use them.

For the Journal of the Franklin Institute.

Particulars of the R. M. Steamer Persia, (Cunard Line.)

Hull and Machinery built by R. Napier & Sons, Glasgow, 1855. Intended service, Liverpool and New York.

HULL.—

Length on deck, from fore part of stem to after part of stern post, above the spar deck,	390 feet.		
" of heel and fore rake,	360 "		
Breadth of beam at midship section,	45 "		
" " over wheel-houses,	71 "	4 inches.	
Depth of hold,	29 "	8 "	
Length of fire rooms,	12 "		
Draft of water at load line,	23 "		
" " below pressure and revolutions,	18 "		
Tonnage (builders), 3586 78-94.			
Masts and rig—barque.			

ENGINES.—Side lever—

Diameter of cylinders,			100½ inches.
Length of stroke,	10 feet.		
Maximum pressure of steam in pounds, 21.			
" revolutions per minute, 18.			
Distance between centres of cylinders,	15 feet	10 inches.	
" " levers,	11 "	3 "	

BOILERS.—Eight—Tubular.

Number of furnaces, 10.			
Length of grate bars,	8 feet	4 inches.	
Diameter of air pumps,		60½ "	
Stroke " "	5 "	1 "	
Diameter of main centres,	4 "	5 "	
Nominal horse power (Admiralty), 850.			

PADDLE WHEELS.—

Diameter,	40 feet.		
Length of blades,	10 "	8 inches.	
Number " 38.			
Height of water wheel shaft,	24 "	3 "	

Remarks.—Floor, *molded*, 10 inches, *sided*, $\frac{9}{16}$ths. Distance of frames apart, *at centres*, 18 and 20 inches. Plates, $\frac{5}{16}$th to $\frac{3}{4}$-inch thick. Rivets, 1 and $\frac{7}{8}$-inch diameter, $3\frac{1}{2}$ inches apart. Keel, $13 \times 4\frac{1}{2}$ inch, keelson form. Has six water tight bulkheads. C. H. H.

For the Journal of the Franklin Institute.

Particulars of the Steamer Everglade.

Hull built by Sneden & Whitlock. Machinery by Morgan Iron Works, New York, 1856. Intended service, Charleston to Florida.

HULL.—

Length on deck, from fore part of stem to after part of stern post, above spar deck,	173 feet.	
Breadth of beam at midship section, above main wales (molded),	28 "	8 inches.
Depth of hold,	8 "	
Draft of water at load line,	4 "	6 "
Area of immersed midship section at this draft,	110 sq. ft.	
Fuel hold—50 cords pine wood.		
Tonnage, 475.		
Masts and rig—One mast with foresail and jib.		

ENGINES.—Inclined—Direct.

Diameter of cylinders,		32 inches.
Length of stroke,	8 feet.	
Maximum pressure of steam in pounds, 25.		
Cut-off—half-stroke.		

BOILER.—One—Single return flued.

Length of boiler,	25 feet.	
Breadth "	11 "	6 inches.
Height " exclusive of steam chimney,	11 "	6 "
Number of furnaces, 2.		
Breadth "	5 "	2 "
Length of grate bars,	7 "	
Number of flues, 15.		
Internal diameter of flues,	18, 13, and 19 "	
Length of flues, 18 ft. 3½ in., and 13 feet		3 "
Diameter of smoke pipe,	4 "	
Height " "	32 "	
Draft, Natural.		

PADDLE WHEELS.—

Diameter,	28 feet.	
Length of blades,	6 "	
Depth "	1 "	10 inches.
Number, 28.		

Remarks.—Floor timbers at throat, *molded*, 14 in., *sided*, 4 in. Distance of frames apart *at centres*, 12 in. Hull strapped with diagonal and double laid iron braces, $3\frac{1}{2} \times \frac{1}{2}$-inch. Keel, 2 inches deep. C. H. H.

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*Improved Process for the Manufacture of Phosphorus.** By HUGO FLECK.

In the course of last year the author published a separate memoir, in which he described an improved process for the manufacture of phosphorus. By this process 100 lbs. of fresh bones furnish 6 to 7 lbs. of phosphorus, and 10 to 20 lbs. of gelatine, whilst the older process only gave 4 to 5 lbs. of phosphorus.

The bones, properly cleaned and broken up, and freed as much as

* From the Lond. Chem. Gaz., No. 330.

possible from fat, are macerated with dilute muriatic acid, by which chloride of calcium and acid phosphate of lime (CaO, 2HO, PO_5) are produced. The maceration is continued until as much as possible of the earthy matter is extracted, and only the cartilage remains. The latter is watered, immersed in lime water, again washed, and then employed in the production of bone-gelatine, which turns out very pure and clear.

The fluid containing the chloride of calcium and the acid phosphate of lime is evaporated. This operation is carried on in glazed stone-ware pans, as metal pans do not present sufficient resistance to the action of the acid fluid. The evaporating pans are heated by the flue from the phosphorus furnace, and the evaporation is continued until the fluid marks about 38° B. It is then allowed to flow out of the pans and cool, when acid phosphate of lime separates in fine crystals. A further quantity of these is obtained by the evaporation and cooling of the mother-liquor. From the mother-liquor of the second crystallization the portion of phosphate still dissolved in it is obtained by mixing it with milk of lime, when phosphate of lime separates, which is treated with muriatic acid, like the residue from the retorts. The acid phosphate of lime, which cannot be washed on account of its solubility, is freed as far as possible from mother-liquor, either by pressing it between cloths, or by spreading it upon a porous plate and producing an imperfect vacuum beneath the latter, when the atmospheric pressure forces the mother-liquor through the plate, upon which the salt forms a white nacreous mass, which crackles between the fingers. This is warmed and mixed with one-fourth of powdered charcoal, passed through a sieve, and then put into the retorts.

For retorts, the author recommends clay cylinders, which, like the retorts of the gas-houses, are placed in fives over each fire. The tubes from each five retorts open into a common receiver; this is of the shape of a muffle, and is placed in a channel through which a stream of water is allowed to flow. The first receiver is connected with a second, similarly arranged. The fuel used is coke and coal. If the acid phosphate of lime was not well freed from the mother-liquor, which contains chloride of calcium, muriatic acid will be formed during the distillation, and thus a smaller amount of phosphorus will be obtained. The mixture of phosphate of lime and charcoal remaining in the retorts is reduced to ashes on iron plates, which are laid on the phosphorus furnace and heated by its fire. The residue of phosphate of lime is then mixed with the phosphate formed by the addition of lime to the mother-liquor, and treated with muriatic acid. By this means chloride of calcium and acid phosphate of lime are again produced; the latter is separated and worked for phosphorus. In this way the entire amount of phosphorus in the bones, with the exception of unavoidable loss, is obtained.

The cartilage, isolated from the bones by means of muriatic acid as above described, is covered with water and exposed to a current of steam, until the solution forms a concentrated jelly, and this, when brought into form dries on cooling into solid cakes. The phosphate of lime still in the membranes gives the gelatine a milky appearance, which is often increased by the addition of white lead, and the gelatine is then sold under the name of patent gelatine. The objections against the bone gelatine

obtained by extraction with acids, which have always prevailed amongst the tradespeople, arose from the employment of acids of too great strength. By the use of a muriatic acid of 7° B. at a moderate heat, and subsequent complete neutralization with lime-water (but not with milk of lime), we have not so much to fear a decomposition of the animal tissues, as that it would cause a diminution of the total product. A far greater injury is done by boiling the gelatine too long, and the treatment by steam is now justly recognised as a step in the manufacture of gelatine.—*Polytechn. Centralblatt*, 1856, p. 681.

For the Journal of the Franklin Institute.

Particulars of the Steamer Christoval Colon.

Hull built by Sneden & Whitlock. Machinery by Morgan Iron Works, New York, 1856. Intended service, South Coast of Island of Cuba.

HULL.—

Length on deck, from fore part of stem to after part of stern post, above spar deck,	180 feet.	
Breadth of beam at midship section, above the main wales (molded),	36 "	
Depth of hold,	8 "	
Draft of water at load line,	3 "	
Tonnage,	450.	
Area of immersed section,	103 sq. ft.	

Contents of fuel hold—50 cords pine wood.
Masts and rig—one mast—foresail and jib.

ENGINE.—Vertical overhead beam.

Diameter of cylinders,		48 inches.
Length of stroke,	10 feet.	
Maximum pressure of steam in pounds,	15.	

Cut-off—$\frac{1}{2}$-stroke.

BOILERS.—Two—Single return flued.

Length of boilers,	24 feet.	
Breadth "	8 "	6 inches.
Height " exclusive of steam chimney,	8 "	3 "
Number of furnaces in each boiler,	2.	
Length of grate bars,	6 "	
Number of flues,	14.	
Internal diameter of flues,	15, 15½, and 9¼ "	
Length of flues,	13 and 10 feet	5 "
Diameter of smoke pipe,	4 "	4 "
Height " "	34 "	
Draft,	Natural.	

PADDLE WHEELS.—

Diameter,	28 feet.	
Length of blades,	7 "	
Depth "		24 inches.
Number "	24.	

Remarks.—Floor timbers at throat, *molded*, 14 inches, *sided*, 4 inches. Distance of frames apart *at centres*, 12 ins. Hull strapped with diagonal and double laid iron braces, $3\frac{1}{2} \times \frac{1}{2}$-inch. Keel, 1 inch deep.

C. H. H.

*The Chemistry of Iron.—On the Composition of some varieties of Foreign Iron.** By F. A. Abel, Director of the Chemical Establishment of the War Department.

There are few subjects of practical importance that have, during the last twelve months, attracted general attention in this country to the same extent as the question of the manufacture of iron ordnance. While numerous plans have been proposed, discussed, and tried for constructing cannon, either of wrought iron, steel, or mechanical combinations of iron material of different kinds, which shall be capable of throwing larger and heavier projectiles than those hitherto used, the question at issue has gradually become one of more general interest, involving considerations intimately connected with the metallurgy of iron, in consequence of the conclusions deduced from the experience in the late war, that the conditions necessary for obtaining a durable and uniform material for iron guns are as yet far from being fully determined.

The American government has lately published a collection of reports, containing some interesting and important observations connected with the manufacture of iron ordnance, though it does not appear that the researches carried on in that country, or the experience gained by the directors of gun foundries belonging to various continental states, have as yet effected much more than the provision of a number of data relating to the nature and quality of iron employed, the different methods of treating the metal and of casting the gun, and the effects of mechanical tests, and of the explosive force of powder upon iron ordnance. There is little doubt that the accumulation of such data, and extensive experiments suggested by their comparison, will ultimately lead to the establishment of the conditions necessary for insuring to iron ordnance uniformity and durability.

The collection in this country of such data as those referred to has hitherto been a matter of great difficulty, from the circumstances that iron ordnance were obtained by Government from various private sources; that no special conditions have been observed in the selection or treatment of metal for ordnance; that no records of the material employed by the different manufacturers have been preserved, and that no system of tests, physical or chemical, has been applied to the metal composing the guns, beyond the regulation proof to which ordnance were submitted before their acceptance from manufacturers. It is obvious, also, from these circumstances, that no uniformity in the iron guns used in this country could be expected.

Now that Government has determined to take the manufacture of iron ordnance into its own hands, the most serious obstacles to the perfection of these important arms in England are set aside, and the introduction of a complete system of testing and of record, together with the results of a very extensive series of experiments, on a sufficient scale, which have already been commenced, will, it is hoped, furnish important contributions to our knowledge of the constitution and mode of treatment of iron, best adapted for the manufacture of ordnance.

* From the Lond. Artizan, December, 1856.

In carrying out the system of experiment determined upon by Government, attention has been directed, in the first place, to iron reduced from its ores by charcoal, this being the material employed exclusively, in some continental States, and to a very great extent in others, in the manufacture of iron ordnance. Much stress is laid, by many authorities on the continent, upon the greater fitness, for this purpose, of that description of iron than of the best hot-blast, or even of cold-blast iron, smelted with coal or coke. It appeared, therefore, naturally the first step, in comparative experiments with various materials, to ascertain the nature of the iron composing the most durable guns manufactured in those countries, and to determine, by comparative experiments here, whether guns manufactured from charcoal iron exhibit great superiority over those made *according to the same system* of iron reduced from its ores by mineral fuel. Various specimens of foreign charcoal pig iron, and cannon of that metal made in France, Belgium, and Sweden, have been collected for comparative examination, and considerable quantities of charcoal-iron, procured from Nova Scotia, Sweden, and America, have been purchased, for experimental purposes. The results obtained, up to the present time, are principally those furnished by the analysis of several of these specimens; and I venture to submit these to the Chemical Society, as they exhibit some points of interest, and may also serve, to others engaged in similar inquiries, as additional means, to those already existing, of comparing the constitution of the varieties of charcoal-iron with that of other descriptions of iron.

It is unnecessary, in the present instance, to enter into analytical details; but, as various methods are employed by different chemists, for determining the most important constituents in iron, it may be advisable to furnish a brief outline of those adopted in performing the subjoined analyses.

The *graphite* was determined by digesting the finely-pulverized iron with concentrated hydrochloric acid, and boiling the residue for some time with a moderately strong solution of potassa: the graphite was collected, washed, dried, and weighed. It was afterwards placed in a capsule and heated to redness in a muffle, until the whole of the carbon was burnt off. The weight of the slight incombustible residue which was generally obtained was deducted from the weight of the graphite.

For the determination of the *total amount of carbon*, the iron was reduced to an extremely fine state of division; it was then first mixed with about twice its bulk of fine sand, or powdered glass, and afterwards with a mixture of chromate of lead and chlorate of potassa. The combustion was conducted in the usual manner, a current of oxygen being frequently employed.

The proportion of *silicium* was ascertained by acting upon the finely-divided metal with concentrated hydrochloric acid, evaporating to dryness, and digesting the residue with hydrochloric acid. The insoluble portion was collected upon a filter, washed until free from iron, dried, and ignited until the whole of the carbon was burnt off. The silicic acid thus obtained was digested with solution of potassa, after its weight had been determined. If any insoluble residue was obtained, its weight was deducted from that of the silicic acid.

To determine the proportion of *sulphur*, hydrochloric acid was allowed to act very slowly upon fragments of the iron, in a suitable apparatus, and the gas generated was passed through a slightly acid solution of acetate of lead. The sulphide of lead produced was collected, washed, and ultimately weighed as sulphate of lead.

The *phosphorus* was determined by digesting, in nitrohydro-chloric acid, fragments of the metal, of the size of small peas, evaporating the solution to dryness, digesting the residue with hydrochloric acid, and separating the insoluble from the soluble portion. The hydrochloric solution was partly neutralized by sesquicarbonate of ammonia, and the greater part, if not the whole, of the sesquichloride of iron reduced to protochloride, by sulphite of ammonia. Solution of acetate of ammonia was then added in excess, and afterwards a small quantity of solution of sesquichloride of iron. The phosphate of lime was precipitated by boiling, collected, and dissolved in hydrochloric acid, and decomposed by sulphide of ammonium. The phosphoric acid was estimated in the usual manner, by pyrophosphate of magnesia.

In the following Table is represented the per centage composition of several specimens of iron, reduced from its ores by charcoal, as calculated from the analytical results :—

TABLE I.

Composition of Pig Iron Smelted with Charcoal obtained from

	Nova Scotia.			America.			France.	Silesia.	
	Grey.	Mottled.	White.	Grey.	Mottled.	White.	Grey.	White, *very crystalline.*	White, *less crystalline.*
Specific gravity,	7·120	7·540	7·690	7·159	7·540	7·675	7·000	7·531	7·604
Iron,	95·20	95·35	95·25	94·87	96·35	96·55	95·18	93·45	90·75
Combined Carbon,	—	1·72	2·96	·04	1·14	2·79	—	4·94	3·62
Graphite,	3·11	1·38	—	3·07	1·50	—	3·40	—	—
Silicium,	1·11	·26	·21	1·80	·79	·32	·80	·75	·25
Sulphur,	·01	·03	·02	trace.	·01	·06	·03	trace.	trace.
Phosphorus	·13	1·30	1·53	·22	·20	·17	·45	·12	3·26
Manganese,	·25	trace.	—	trace.	trace.	trace.	—	5·38	2·00
Copper,	—	—	—	trace.	trace.	trace.	—	·24	trace.
	Traces of Titanium and Cobalt.						Traces of Arsenic and Chromium.	Traces of Cobalt.	

The specimens of white iron from Silesia differ from one another in several respects, and to such an extent, as to prove that they were obtained from different ores. Both were very hard and brittle; but the ore containing the largest amount of manganese exhibited a foliated structure and brilliancy of lustre, very similar to that of refined antimony,

while the other specimen, rich in phosphorus, was less brilliant and far more compact. These irons were proposed for admixture with dark grey iron; but it was considered that they could not be advantageously employed for this purpose.

The French iron examined was a specimen of the metal reduced by charcoal from hæmatite ores, at the Government cannon foundry of Ruelle, and employed exclusively in admixture with charcoal iron also reduced from similar ores in the neighborhood, for the manufacture of ordnance. It was dark, soft, fine-grained, and uniform in texture. In its general characters it was similar to the Swedish grey iron analyzed, though exhibiting a superiority over the latter in reference to the amount of silicium it contains.

The specimens of American and Nova Scotia iron analyzed were taken as average samples from large parcels of the metal purchased by Government for experimental purposes.

The different varieties of iron from each source exhibit such differences in their composition as are generally observed in irons reduced from the same ore under modified conditions. Both the Nova Scotia and American irons are of excellent quality, and furnish the best results when submitted to physical tests. Comparative trials are about to be made of their merits as gun-metal.

The subjoined Table exhibits the results of the analyses of four specimens, from guns of foreign manufacture.

TABLE II.

Composition of Iron Gun Metal from

	BELGIUM.	FRANCE.	SWEDEN.	RUSSIA.
Specific gravity,	7·250	7·250	7·050	7·135
Iron, ...	95·61	96·02	95·87	94·36
Combined Carbon,	·78	1·03	·18	·47
Graphite, . . .	2·12	1·87	2·62	2·83
Silicium, . . .	·09	·35	1·19	1·10
Sulphur, . . .	·06	·03	·08	·02
Phosphorus, . .	·29	·45	·11	·37
Manganese, . .	·15	·25	trace.	·85
Titanium, . .	traces.	traces.	trace.	trace.
	Traces of Chromium, Arsenic, Zinc, and Copper.	Traces of Chromium and Tin.	Traces of Chromium.	Traces of Tin.

The Swedish metal examined has great resemblance to that composing the Russian gun, which was one of those lately captured and selected for experiment. A severe proof to which this gun was submitted showed that the metal composing it was of excellent quality.

The Swedish metal was of a uniform light grey color, while the Russian gun exhibited a slightly mottled appearance. Both contained the graphite in a finely divided state. It is worthy of remark, that the strength

and durability of Swedish iron guns is found to be variable; which circumstance is ascribed to the very general practice of casting the guns directly from the blast furnace, instead of first submitting the metal to treatment in reverberatory furnaces.

The specimen of French gun metal was obtained from the cannon foundry at Ruelle. It resembled, in a remarkable manner, several specimens of iron gun metal obtained from the cannon foundry at Liège, of which the composition of an average sample is also given in the above Table. Both kinds were mottled iron of very uniform character, exhibiting a short and regular fracture, and a fine and compact structure. Their specific gravities are identical, and the differences exhibited in their composition are but slight. For the preparation of the French gun metal, a mixture of various descriptions of charcoal pig iron, obtained at Ruelle, is made with grey pig iron, from other similar iron works in the neighborhood (*e. g.* from *La Chapelle* and *Etouars*), with old French cannon, and with the "dead heads" from former castings. By a protracted treatment in reverberatory furnaces, these metals undergo thorough mixture, and purification at the same time, and are converted into the uniform mottled metal above referred to. The fuel used for the remelting and mixing is Newcastle coal.

At the Belgian Government cannon foundry a certain proportion of hot-blast iron, smelted with coke, is employed in admixture with old cannon, "dead heads," and charcoal pig iron, obtained from various smelting works, more particularly in the neighborhood of Charleroi. The fuel used for the remelting is a semi-anthracite coal, from Belle Vue, in the neighborhood of Liège, and has the following per centage composition:—

Carbon,	85·56
Hydrogen,	4·20
Oxygen,	2·40
Nitrogen,	1·92
Sulphur,	1·00
Ash,	4·92

The per centage of phosphoric acid in the ash is 1·60.

The same care is taken to ensure the production of a metal of uniform structure as at Ruelle; and the excellent results obtained by the proof of the guns, and by the mechanical tests to which the metal is submitted, bear very strong evidence in favor of the superiority of iron of the particular constitution and structure produced in Belgium and France, for the manufacture of guns, over other kinds of iron, even equal to it in chemical quality.

Unquestionably the repeated exposure of grey iron to a moderately oxidizing action, in the reverberatory furnace, has the effect of improving its quality, and of removing one of the impurities most objectionable in iron which is to possess tenacity and elasticity—namely, silicium. In experiments lately made, in connexion with some patent processes for improving the quality of iron, it was found that the oxidizing action of air upon highly heated iron had the effect of removing the silicium entirely, before the amount of carbon existing in the metal was diminished in any sensible degree. The close-grained and very uniform structure of the iron produced by the mixing and remelting processes, on the Con-

tinent, and the very finely divided condition in which the graphite exists in the iron, are elements affecting the durability of the gun metal, of equal importance to the purity of iron. Some pieces of iron ordnance which have either burst upon proof, or after having been but a short time in use, and the metal composing which was of good quality and even of an unusually pure description, evidently owed their incapability to resist the force of gunpowder to the comparatively loose structure of the metal, and to the existence of the graphite in large scales. There are, moreover, various points to be taken into consideration, in connexion with the *method of casting guns*, which cannot be entered into here; but which, doubtless, greatly influence their physical structure, and, consequently, their durability.

It would be premature to attempt a comparison between the merits of charcoal iron and those of the better qualities of British coal-blast iron, as materials for ordnance, from results of analyses alone; but thus much is certain, that iron smelted with mineral fuel may be obtained in abundance in this country, which contains not more phosphorus or sulphur than are found in average specimens of charcoal iron, and that abundant proofs already exist of the ease with which silicium may be removed from pig iron, by judicious treatment. It may, therefore, be confidently expected that future experiments on the casting of ordnance, with various kinds of iron, will prove that we are not dependent upon a supply of charcoal iron, for the production of durable guns.

As an appendix to this communication, I beg to lay before the Society the results of an analysis of a specimen of the cast steel manufactured by Krupp, of Essen, of which such beautiful specimens were exhibited at the Paris Exhibition of 1855.

This cast steel was proposed, by M. Krupp, as a material for ordnance, as far back as 1847, and the first small gun (a 3 pr.) cast of it was submitted to very severe tests, in Berlin, in 1849, and finally proved to bursting. A 12-pr. gun of the same material, was afterwards sent for trial to this country (early in 1855), after having likewise withstood very severe tests. At about the same time, a cylinder of the cast steel was sent from Essen, and bored by Messrs. Walker, of the Gospel Oak Works, to the calibre of an 8-inch gun. Its breech was fitted with a cast iron case, or jacket, the thickness of which was 10 ins. at the breech, and 8·5 in front of the trunnions. The weight of the gun complete was 8 tons 5 cwt. The case was in contact with a steel barrel only at its two extremities, at the breech and the middle of the barrel; at the latter place a wrought iron wedge-ring was fitted into the barrel, and fixed to the jacket by screws. This gun was proved at Woolwich, but bursted the first time it was fired. The probable cause of this unexpected result has been a subject of some public discussion in Germany, but there is little doubt that it was due to the injudicious form of projectile (weighing 259 lbs.) which the parties who proposed to Government the experiments with cast steel, and provided the gun for trial, insisted upon employing for the proof.

The gun was broken into ten large pieces, and a number of small fragments. The various fractures of the cast steel did not exhibit any imperfections, to which the bursting of the gun could have been ascribed.

The metal was very uniform, compact, and hard. A fragment was selected for analysis, and furnished the following results :—

One hundred parts contained—

Iron,	98·05
Combined carbon,	1·18
Silicium,	0·33
Phosphorus,	0·02
Manganese,	*trace.*
Cobalt and Nickel,	0·12
Copper,	0·30

No sulphur was detected.

The specific gravity of the specimen analyzed was found to be 7·826.

The preceding paper is a condensed report of a communication read before the Chemical Society.

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*Du Tremblay's Combined Ether and Steam Engine.—Burning of a French Steamer at Bahia.**

"The screw steamer *La France* was built at Marseilles about two years ago, and was first employed in the transport of troops to the Crimea. Her hull and several of her main divisions were of iron ; her tonnage was 2200 tons, and the power of her steam and ether boilers and engines, 350 horses. She was fitted up with apparatus for the use of the vapor of ether as well as steam from coal, according to the system of M. Du Tremblay. It is stated that, by this plan, 15 tons only of coal and 60 litres of ether are required for the 350 horse engines for each 24 hours; whereas, if coal only were used, a consumption of nearly three times that weight would be necessary. It will be seen from this, that if the system can be safely adopted, it would prove a disideratum for long voyages. In the present instance, there is no doubt that the conflagration was originated by the want of care about the ether, as will be seen when I go into particulars. *La France* was the second vessel of the Marseilles line of steamers to the Brazils. She was on the outward voyage, and anchored in the Bay of Bahia on the 25th of September. She was preparing for her continued voyage to Rio de Janeiro on the 28th ; but at about half-past ten o'clock on the night of the 27th, three men were engaged with lanterns in shifting luggage or cargo on the lower deck, when they smelt a strong odor of ether; and thinking that some accident had taken place, two of them succeeded in extinguishing their lights, but the third in the attempt to do so, upset his lamp, and set fire to some ether alleged to have been spilt upon the floor. One man was seriously burnt, the other two slightly. I could obtain no explanation of the reason why ether should have been in such an unsafe place. The ship was instantaneously in flames ; guns were fired, bells were rung, the news was conveyed to Captain St. Brue, the commander of the ship, who was on shore with the consignees, arranging for the departure on the morrow. The local authorities of the city, the officers from the arsenals, and from the vessels in port, hastened to afford all the assistance in their power ; the passengers and their baggage were got safely ashore, and about three o'clock

* From the Lond. Artizan, Dec., 1856.

in the morning the fire seemed to be entirely put out, and the captain dismissed the assistance given to him. Notwithstanding this confidence, the flames again broke out with fury, and this time there was not the means of subduing them. It was found impossible to save the ship; and owing to the fear of explosion of the ether, which was known to be in cisterns on board, it was found impossible to get lighters to go alongside to take away the cargo, or to make the tug-boat available to tow the blazing ship into shallow water. It was determined, therefore, to sink her where she lay; and, about ten in the morning, the plugs in the ship's bottom were drawn out, and the vessel sunk, leaving her chimney and awning stancheons above the water level. Just before the *Avon* passed through Bahia, the hull of the sunken vessel and its contents had been offered by public auction, and sold for about £5000. Attempts are intended to be made immediately for the raising of the vessel, her machinery, and the cargo; and the purchaser is sanguine of being able to realize a large sum by the transaction. The vessel was insured for a sum of about £50,000. I avail myself of the opportunity of giving the following brief description of the system of Du Tremblay, which I was favored with by an engineering friend:—The engine for working by the vapor of ether, invented by Du Tremblay some three years ago, consists of a large working cylinder, with a piston as usual, but having an outer casing, or, as we should call it, a steam jacket, into which the used steam is discharged from the cylinder. This contains a number of tubular chambers of an oblong section, say about 1½ in. by ½ in. in area. These tubes may be considered as constituting the ether boiler, as they contain that liquid; and, being surrounded by the steam, vapor of ether is generated at such a pressure as to be available for working a piston and machinery, much in the same way as in the steam engine."—*Manchester Guardian.*

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*On the Preparation of Drying Oil.** By Prof. R. Wagner.

The author repeatedly prepared protoborate of manganese for lacquerers, in accordance with the directions of Barruel and Jean. He effected its precipitation whilst hot, and thus obtained it of a coffee-brown color, and consequently containing much oxide, but still always of remarkable efficacy. As, however, Barruel and Jean expressly observe that the action is proper to the protosalts, the author endeavored to obtain it perfectly free from oxide, and for this purpose effected the precipitation with borax cold. He obtained a snow-white powder, but this furnished no varnish. He therefore returned to the previous mode of preparation with the assistance of heat, and found that it was obtained of the darkest brown, and also of the strongest action, when both the solutions of sulphate of manganese and borax were diluted as much as possible and mixed boiling. The siccative action upon the oil must therefore be ascribed to the oxide, and not to the protoxide.

By further experiments the author found that the boracic acid is quite superfluous, and that free oxide of manganese or its hydrate is as efficacious as the borate. The oil need only be heated for a very short time

* From the Lond. Chem. Gaz., No. 338.

(about a quarter of an hour) with about one-eighth per cent. of oxide or hydrated oxide of manganese. The heat applied need not approach the boiling-point by a long way; but no general temperature can be given, as new oil has a much higher boiling-point than old. The siccative quality, however, increases with the heat. But as the oil becomes darker and thicker in proportion to the heat to which it is exposed, it is the best plan in general to remove it from the fire as soon as it clears and begins to fume very slightly. Streaks of it now become firm in twenty-four hours. To obtain the drying oil of a very pale color, it must be heated still less. The drying is thus retarded several hours, but the color has scarcely become perceptibly brownish, whilst in the former case it always acquires a chestnut-brown color.

The author obtained a wine-yellow oil, quite unaltered, without heat, by mixing 1 per cent. of hydrated lime with a linseed-oil four years old, which dried by itself in three days. After being frequently stirred for two days, a streak of it was perfectly firm in twenty-four hours. Oil of the same year, however, did not become siccative even by boiling with lime.

The oil dissolves very little of the small quantity of oxide of manganese, and the salt when removed may be repeatedly used in the preparation of drying oil. When prepared oil is mixed with an equal weight of crude oil, it requires nearly twice as long to dry; with twice the quantity, twenty hours longer; and with three times the quantity, another twelve hours; but the time necessary for the solidification of the coating gradually diminishes a little by long standing.—*Kunst- und Gewerbeblatt für Bayern*, 1856, p. 314.

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*On the Preparation of Chemically-pure Sulphuric Acid.**

By F. Vorwerk.

Some time ago Russegger described a method in which, by a particular arrangement of the retorts, sulphuric acid may be distilled by boiling without thumping, and the rectification of the crude acid may be effected without the employment of platinum wire. Instead of this the author recommends the following process, which fulfils the same purpose, and dispenses with all further particular arrangements.

Into a long-necked plain retort, which had already served several times for the preparation of nitric acid, 5 lbs. of slightly brown English sulphuric acid, of spec. grav. 1·832, and free from arsenic, were put. The retort was put upon a layer of sand of the depth of a finger in the sand-bath, and surrounded with sand, so that it was buried up to the neck. A long-necked flask served as a receiver: it was simply pushed over the neck of the retort without any luting. Commencing with a moderate heat, this was gradually raised until the sand-bath became red hot, during which the distillation went on quite regularly without any thumping. Notwithstanding the heat to which the retort was exposed, the receiver did not require to be cooled until after six hours' working, and even then only by wrapping a wet cloth round the neck. The distillate was

* From the Lond. Chem. Gaz., No. 338.

removed from time to time, and tested as to its purity and specific gravity. The first 5 ozs. that passed, had a specific gravity of 1·20, and exhibited no impurity except a considerable quantity of sulphurous acid. The second portion of 3½ ozs. of distillate, with a specific gravity of 1·75, still contained a trace of sulphurous acid. A third portion of 2½ ozs. was pure, and had a specific gravity of 1·850.

Fourth portion of 1½ lb. spec. grav. 1·855
Fifth portion of 13 ozs. spec. grav. 1·860
Sixth portion of 9 ozs. spec. grav. 1·885

With this the distillation was concluded, to enable the contents of the retort to be examined. The uninjured retort contained the remainder of the sulphuric acid as a limpid fluid with a white sediment (persulphate of iron), from which no doubt ½ lb. of pure distillate might still have been obtained.

In such distillations, particular attention is to be paid to the quality of the retort. It is always advisable to anneal the retort before using it, by heating it as strongly as possible in the sand-bath, and letting it cool slowly and completely therein.—*Neues Jahrbuch für Pharm.*, v. p. 257.

Action of Tannin upon Skin.

The investigations which M. Payen laid before the Academy of Sciences (*Paris*), are only the prelude to an attempt to get at, if it be possible, the knowledge of the phenomena which are going on during the operation of tanning, and to establish a theory of this operation, still so obscure to the chemist. In this first part, he has endeavored only to examine thoroughly and show the generality of a fact, which he had observed several years ago. This fact is, that there exist in the skin two portions which present different properties, when they have undergone the action of tannin. One of these is easily disaggregated, soluble in ammonia-water; the other preserves its fibrous texture, and resists the action of the re-agent, although frequently renewed. The saturation of the skin by the tannin takes place long before the time practically required for good tanning; and requires for the two parts much less tannin than gelatine. The compound formed with the tannin, by the less cohesive parts of the skin, when it has been dissolved in ammonia, is changed in dissolving; it undergoes, besides, a considerable loss of nitrogen during its evaporation to dryness. The effects of long-continued tanning cause the gradual solution of the less cohesive portions united with the tannin, and consequently a relative increase of the quantity of resisting fibrous material. The product, in this case, must therefore be both more pliable and more tenacious. The friable soluble portion which remains in the tanned leather is unstable; in dissolving, it may withdraw considerable quantities of the azotized substance; and it is thus, perhaps, that the less cohesive part of the skin is removed during the long operations of tanning. These are, in substance, the remarks which result from the observations and analyses reported in detail by M. Payen. The author proposes to examine successively all the operations of tanning, and to study separately the effects produced

by lime, soda, by ammonia, the formation of which is determined by the foregoing bases, by dilute sulphuric and lactic acids, &c.—*L'Institut, 26th November.*

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*Synthesis of Carburets of Hydrogen.** By M. Berthelot.

1. The action of a mixture of sulphuret of carbon and sulphuretted or phosphoretted hydrogen upon copper at a dull red heat, produces hydrogen, marsh gas, $C^2 H^4$, a considerable quantity of olefiant gas $C^4 H^4$, and a trace of naphthaline.

The proportion of olefiant gas may be rendered more considerable by the action of a mixture of sulphuret of carbon, marsh gas, and carbonic oxide on iron. In these circumstances, the proportion of olefiant gas formed may be such that its carbon will be equal to one-sixteenth of the carbon of the sulphuret decomposed.

The marsh gas formed in these experiments could be isolated by the use of solvents. The olefiant gas was collected in bromine, and disengaged in a state of purity from the bromine compound by a process which will be presently indicated; this olefiant gas was afterwards converted into crystallized sulphovinate of baryta and characteristic benzoic ether.

Thus the synthesis of alcohol by means of the simple bodies of which it consists may be regarded as an accomplished fact, for sulphuret of carbon is obtained by the direct union of carbon and sulphur.

2. In the dry distillation of formiate of baryta, carburetted hydrogen gas, olefiant gas, $C^4 H^4$, and propylene, $C^6 H^6$, are formed. Hence, it follows that these two carburets and the corresponding alcohols may be obtained by complete synthesis; for I have shown, on the one hand, that the formiates may be prepared by means of oxide of carbon, and on the other, that the preceding carburets may be converted into the corresponding alcohols by the intervention of sulphuric acid or of the hydracids.†

3. If carbonic oxide and purified marsh gas be passed together into a tube heated to dull redness, a small quantity of propylene, $C^6 H^6$, is obtained. Marsh gas alone does not furnish anything of the kind under the same conditions.

4. In the dry distillation of acetate of soda, olefiant gas, $C^4 H^4$ (in very small quantity), propylene, $C^6 H^6$, butylene, $C^8 H^8$, and a little amylene, $C^{10} H^{10}$, are formed. The carbon contained in these various carburets may rise to one-twentieth of the total carbon contained in the acetate. It will be observed that the acetates are prepared simply by means of the alcohol derived from the olefiant gas which is formed in the preceding reaction.

5. The various carburets just referred to were condensed in bromine, and studied separately after being disengaged in a pure state by the following process. The bromine compound is heated to about 482° F., in a hermetically-sealed tube, with copper, water, and iodide of potassium. By

* From the Lond. Chem. Gaz., No. 335.

† Propylene combines directly with muriatic, hydrobromic, and hydriodic acids, forming the corresponding ethers.

this process, olefiant gas, propylene, &c., may easily be regenerated from their bromides. If the copper be omitted, the hydrurets of the carburets of hydrogen are obtained; thus the bromide of olefiant gas, $C^4 H^4 Br^2$, furnishes the carburet $C^4 H^6$, and the bromide of propylene, $C^6 H^6 Br^2$, gives the carburet $C^6 H^6$. This is a very general process of inverse substitution.

6. From the preceding facts, and the relations which exist between the carburets of hydrogen and the alcohols on the one hand, and the alcohols and the other organic compounds on the other, we may regard the complete synthesis of a great number of organic compounds as an accomplished fact.—*Comptes Rendus*, July 28, 1856, p. 236.

FRANKLIN INSTITUTE.

Proceedings of the Stated Monthly Meeting, December 18th, 1856.

B. Howard Rand, President, pro tem., in the chair.

Isaac B. Garrigues, Recording Secretary.

The minutes of the last meeting were read and approved.

Letters were read from the Royal Society of London, and the Royal Institution, London.

Donations to the Library were presented from the Commissioners of Patents; The Society of Arts, Manufactures, &c.; The Zoological Society, London; The Royal Irish Academy, Dublin; The Ecole Imperiale des Mines, Paris; K. K. Geologischen Reichsanstalt, Vienna; Hon. R. Brodhead, United States Senate; The Smithsonian Institution; Hon. Commissioner of Patents, and Thomas U. Walter, Esq., Washington City, D. C.; The Governor of Pennsylvania; The American Institute, City of New York; The Union College, Schenectady, New York; Messrs. Charles E. Smith, D. and E. Parrish, Philip Price, Henry Quig, and Professors Jno. F. Frazer, and J. A. Kirkpatrick, Philadelphia.

The Periodicals received in exchange for the Journal of the Institute, were laid on the table.

The Treasurer's statement of receipts and payments for November was read.

The Board of Managers and Standing Committees reported their minutes.

The Committee on Exhibitions presented so much of their report on the late Exhibition as refers to specimens of De Laines manufactured by the Manchester Print Works, New Hampshire, for which they recommend the award of a Gold Medal, and also,

To the specimens of De Laines manufactured by the Hamilton Woolen Co., Southbridge, Mass., and the specimens of Chemicals by Powers & Weightman, of Philadelphia, for which they recommend the awards of the Recall Gold Medals.

The Chairman also read the report on the Chandeliers, Lamps, &c., by Cornelius & Co., of Philadelphia.

On motion the awards were made in accordance with the report.

Seventy-six resignations of membership in the Institute, were read and accepted.

Candidates for membership in the Institute (141) were proposed, and the candidates proposed at the last meeting (22) were duly elected.

Nominations were made for Officers, Managers, and Auditors of the Institute for the ensuing year.

On motion, it was

Resolved, That the polls for receiving the votes of the members of the Institute for Officers, Managers, and Auditors for the ensuing year, at the Annual Election to be held on Thursday, January 15th, 1857, shall be opened at 3½ o'clock, and closed at 8 o'clock, P. M., and that seven members be appointed by the President a committee to receive the votes, and report the result thereof.

Mr. Maskel's patent sliding keel was exhibited and explained to the members. It consists of a plate of iron, or other suitable metal, which is moved vertically in a recess made for it in the keel. A link at each end attaches the plate to the keel, provision being made by slitting the pin-holes of the links, to allow for the raising or lowering of the plate, which is accomplished by racks and pinions, or other suitable machinery, worked on the vessel's decks, the attaching rods passing through water-tight tubes extending from the top side of the keel to the deck. The depth to which the sliding keel can be lowered, is of course limited by the depth of the main keel: being somewhat less, but its length being nearly that of the main keel, a sufficient area is presented to prevent that motion of the vessel technically termed "flatting off," which would otherwise take place under a side wind. The old-fashioned sliding-keel is objectionable, as the "well" or opening in which it slides runs fore and aft of the vessel, for one-fourth or one-third of her length, and requires the deck beams and frames for that length to be cut entirely through, thereby much diminishing the strength of the hull. Mr. Maskel's plan requires no such sacrifice; nothing is cut through; but the hull is built in the usual way, except the recess in main keel. For vessels navigating the shallow rivers and bays of our Southern coast it must prove valuable, particularly in the cotton districts, where the largest vessels of deep draft, unable to come in, are loaded by means of lighters. The plan is favorably reported on by a commission of United States Naval officers, and is approved by some of the most eminent naval architects of the country. Mr. Maskel has asked for an examination and report of its merits by the Committee of Science and Art, which may be looked for in the pages of the Journal.

BIBLIOGRAPHICAL NOTICES.

Manual of Coal and its Topography, illustrated by original drawings, chiefly of Facts in the Geology of the Appalachian Region of the United States of North America. By J. P. Lesley, Topographical Geologist. Philadelphia: J. B. Lippincott & Co., 1856. 18mo., pp. 224.

The unpretending title of this little work is very far from expressing either its scope or value. In place of a manual of one material, or of the rocks with which it is exclusively associated, we have here an admirable treatise on the geology of the older rocks of North America, as they lie

developed on its eastern border, plainly written, and so far avoiding mere technicalities, as to be both intelligible and interesting to the general reader, while it is so accurate and logical in its statements, as to give it a very high value as a strictly scientific treatise. The point of view from which it is written is also not without novelty, being a happy mean between the dull, technical description of minerals and the rocks which they form, and the vague generalization of unsustained hypotheses with which we have been so annoyed in America.

The work itself is divided into four chapters; the first of which, "The General Relationships of Coal," contains an admirable account of this invaluable material, its various kinds and varieties, the manner of its occurrence, the rocks and minerals with which it is associated, the means of detecting its presence, and the peculiarities by which the same bed may be identified, when seen at different localities. This chapter, which includes within itself almost all that is promised in the title of the book, will be found very valuable to our coal-owners and proprietors, who are still too much in the habit of relying upon the experience of foreign miners and geologists, who lead astray by analogies which are true in their own countries, but false here, and advise expensive workings in unprofitable positions, while they pass unheeded valuable seams. Those who have a practical interest in these matters, will find in this chapter a succinct statement of the analogies and differences of our coal and that of Great Britain, and will be enabled, by carefully studying it, to form enlightened opinions on the capacities of those whom they may employ to survey for them.

The next chapter, or "The place of Coal among the Formations," is very interesting, giving a brief and clear account of the rocks in and above which the coal lies, and a comparison of the nomenclature of these rocks, as adopted by the various geologists. One of the great misfortunes arising from the mutual jealousies of the geologists who have conducted the separate State surveys has been, the giving different names to the same rock as it occurs in different states; and as is the almost uniform experience in such a case, the worst system of names is that which has been most widely adopted. Prof. H. Rogers, who from the early period at which he started the surveys of New Jersey and Pennsylvania, as well as from correspondence with his brother in Virginia, might have secured to himself the questionable honor of an early and imperfect system of nomenclature, judiciously, as we think, abstained from so doing, and contented himself with a temporary notation of the strata by numbers, so as to allow of the postponement of the final naming, until the extension of the system of State surveys had given us more knowledge of their nature and extent. His example has unfortunately not been followed by others, and a bad system of local names has been the result. The description of the coal beds themselves, given here by Mr. Lesley, will commend itself to all who have a practical interest in the subject, by its great minuteness and accuracy, and the care with which all available information of the subject has been digested.

The third and fourth chapters are the most novel, and will probably be found the most interesting to the general reader; they treat of topography first as a science, then as an art; and we do not know where we